SCIENCE ATTITUDES, LOCUS OF CONTROL, CAREER COMMITMENT AND EXPERIENCES OF ACADEMICALLY TALENTED HIGH SCHOOL FEMALES

By

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To Gavin Letts, my adopted father,
whose belief in my talent and high
expectations have inspired me to achieve,
and
To Diane Farris, my dear friend,
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even through the most difficult of times.

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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

SCIENCE ATTITUDES, LOCUS OF CONTROL, CAREER COMMITMENT AND EXPERIENCES OF ACADEMICALLY TALENTED HIGH SCHOOL FEMALES

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This study was designed to determine whether an intensive science experience affected academically talented female adolescents differently as compared to males. The three dependent variables were (a) science-related attitudes, (b) science locus of control, and (c) commitment to a science career. Also of interest were gender differences in students' prior science-related hands-on and encouragement experiences.

A pretest-posttest design was employed. Four instruments were used to measure the variables: The Test of Science-Related Attitudes (TOSRA), Science Attitudes Survey (SAS), Locus of Control in Science (LOCiS), and Science Impact Questionnaire (SIQ). A questionnaire to measure

prior science-related experiences was developed by the researcher. Three instruments and the questionnaire were administered to ninety-eight participants, 47 females and 51 males, at the beginning and end of an intensive science experience. The experience questionnaire was given at the beginning of the treatment. The Science Attitude Survey was administered as a posttest only measure.

The results indicated that males and females were significantly different before the treatment only in their expressed attitudes as measured by the TOSRA. Treatment effects were found on the TOSRA with scores declining except for females' view of scientists as normal which increased. Males and females responded differently to commitment to a science career (SIQ) after the treatment; males arrived and remained more committed to a science career than females. Significant differences by gender were found on three scales of the SAS given as a posttest only. The females were more positive than males on attitude toward women in science, competition in science with the opposite gender, and feeling about success in science.

In conclusion, males and females continue to report different views of and commitment to science. Positive changes did not occur as a result of the treatment except

for females' view of scientists as normal people. The SAS appeared more sensitive to females' positive science attitudes than the TOSRA.

CHAPTER I
INTRODUCTION

In the United States there will soon be a serious lack of qualified technical personnel unless more students enter the scientific fields of study (Government-University-Industrial Roundtable report, 1987). Overall, the number of 22-year-olds is expected to drop by 25% by the end of this century, with proportionate decreases in the numbers of young scientists. At the same time, the demand for technical personnel has been increasing steadily. A remedy for this situation that has been suggested and supported by a number of educators is to recruit academically talented students into science careers who typically do not select such careers. Currently, those who choose science careers are predominantly middle-class white males (Sherburne, 1988). One way to enlarge the nation's technological talent pool is to recruit more academically talented women into fields in which they are currently underrepresented.

In 1986, 44 percent of the persons in the nation's labor force were women, while only 15% of the scientists were women (Malcolm, 1988). The 15% figure represented an

increase from the figure reported in 1976 when only 9% of scientists were women. The proportion of women to men in the scientific fields has been increasing, but a total of 15% females is still disproportionately low. Clearly, the rate of increase of women entering technical fields has not been substantial enough to meet the critical needs of the nation. The need to attract more academically talented females into careers in science has been addressed by researchers in education who have proposed various instructional and motivational programs aimed at overcoming the disparities in male and female achievement in science. Yet, female achievement in science has continued to be low proportionate to that of men. The problem of disparity still exists (Malcolm, 1988).

Gender Disparity in Science

Malcolm (1988) reported the findings of the study of the achievement of nine-year-olds on the 1985 National Assessment of Educational Progress (NAEP) in science, mathematics and reading. The conclusion was that there was only slight variance in achievement between males and females. The nine-year-old girls scored higher than boys in reading. Boys scored only slightly higher than did the girls in science. Girls as well as boys in elementary

school had the cognitive ability to succeed in careers of their choice. However, one significant difference in regard to choosing scientific careers appeared in the scores on the attitude component of the NAEP: boys scored 2.6 percentage points higher than females when indicating a more positive attitude toward science.

By age 13, males' and females' scores varied to a greater degree, especially in the scientific area of the 1985 NAEP. Mathematics scores were similar for both sexes, while the females' scores continued to decline in science performance and attitudes. Females continued to perform higher than males in reading. By 17 years of age, score differences in both mathematics and science on the NAEP had increased significantly in favor of males, while females continued to be ahead in scores obtained in reading (Malcolm, 1988).

These score patterns of males and females are indicative of gender differences in science achievement that begin to appear in early adolescence and continue to increase in later years. The difference in male and female achievement in science does not appear to relate to cognitive factors per se since at age nine, males and females had similar scores. Other critical factors appear to have contributed to the downward trend in female scores

that has been observed to begin in early adolescence. If females are as capable as males in science achievement, then the problem may be one of motivating females to choose science careers or to focus on science in their studies. Various means have been proposed and tried by educators. Keeping females interested in pursuing scientific careers, however, has proven to be a complex task involving more than cognitive factors.

Theoretical Framework--Career Choice

Choosing a career in contemporary United States society in which a vast number of careers are possible involves decision making for persons of both sexes. For academically talented and gifted persons, career choices have been especially difficult because often these people have been achievers in a variety of areas. Understanding persons' career choices has been related to the concept of their development in the stages of their lives (Super, 1957). What individuals have experienced in their early years, what they learned about jobs, and what jobs they have held, have influenced their career choices.

Super based his work upon the life stages theory of Buehler and the sociological study of work by Form and Miller (1949). The earliest period was termed the growth

stage by Buehler, and as the preparation for work stage (Form & Miller, 1949). Individuals of approximately 15 to 25 years of age experience the exploratory stage (Buehler, 1933), and the trial work period (Form & Miller, 1949). Youth of both sexes have tried out adult roles and found their adult occupations as they have tried summer jobs and part-time work. These experiences have provided them with information and role models and revealed life patterns related to career choices.

Four career patterns have been identified (Super, 1957). They are (a) stable life pattern--education or training leads to job, (b) conventional career pattern--initial job trial period and stable employment, (c) unstable pattern--trial, stable job, another trial, and (d) multiple-trial period. These patterns have been associated with certain career choices. Variations from these characteristic patterns have occurred. Giving adolescents knowledge of career patterns and possible variations has assisted youth in making career choices.

For females, however, career patterns have been more complex (Super, 1957). Biological, psychological, and social factors have been associated with their roles as wives and mothers and have influenced their career choices. Three additional career patterns have been

identified for females. These were (a) stable homemaking career, (b) dual-track career pattern--wife, mother, and job-holder, and (c) interrupted career/job, wife/mother, job.

Not only have there been more patterns for females, but also choices have been more complex for females within the four patterns males and females have experienced. Women who are mothers, for example, could have chosen to be less achieving in their stable careers, a choice approved in the United States. It has not been acceptable for men to lower their goals because they are fathers (Kerr, 1983).

Females' career choices have been made even more complex by the conflicting messages they have received in their growth period when they developed an orientation to the world of work. Females have perceived conflicts in their potential roles as wives and mothers and as achieving persons, especially in fields identified as masculine. Women have been nurses and teachers, traditionally female at nonadministrative levels. They could move if necessary; thus they could adapt themselves to the demands of their husbands' careers (Super, 1957).

In the 1980s, girls were expected to be engineers and doctors. Yet, they have been rewarded in school for being

passive and doing neat work rather than making difficult intellectual efforts (Sadker & Sadker, 1985). They have been given dolls to play with more often than cars and blocks. Girls' lack of achievement in scientific tasks has been related to their early experiences (Kahle, 1983). At least 50% of variance in achievement in science has been related to factors other than cognitive. Sherburne (1988) concluded that 25% of the variance could be related to instruction and programs, and as much as 25% was accounted for by affective factors.

Chipman and Thomas (1987) presented a model to explain the affective factors contributing to females' lack of participation in science. She suggested that expectations of success and the value given to the outcome form the basis of females' decisions not to participate in science. Chipman and Thomas (1987) also has suggested that, although cognitive ability is an important predictor of persistence in science, it is unlikely that sex differences in ability contribute significantly to the observed sex differences in participation. She suggested that different interest patterns and confidence in ability may explain the sex differences in participation. Researchers have indicated that a number of factors have been identified as negatively influencing the science interest and confidence level that

Chipman has suggested. These factors include both external and internal barriers.

External Barriers

Academically talented females have received overt and hidden messages from persons and institutions in United States society that have inhibited girls from developing their scientific interests and abilities (Kerr, 1985; Reis, 1987; Reis & Callahan, 1989). Parents have often conveyed, in a subtle manner, different expectations for their sons and daughters. Parents have encouraged their gifted daughters to achieve and pursue productive careers, but at the same time have refrained from teaching them independence and risk-taking skills. Parents were often reported to be more concerned with their daughters' social adjustment than with their academic boredom (Kerr, 1985). Parents have continued to encourage sons more than daughters to pursue careers in science, mathematics and computer studies (Sanders & Stone, 1986). Early experiences have been found to be related to boys' and girls' in-school science and mathematics learning (Fox, 1978). Girls have learned proper accomplishments like handicrafts; boys have played competitive sports. The toys that boys were given to play with more often than

girls, like blocks and other building objects, developed their spatial skills and object-manipulation experiences needed as preparation for science studies in school (Fox, 1978). The differential treatment of girls may be unconscious on the part of parents, who present their daughters with conflicting messages.

The differential treatment of boys and girls is carried over into school. Dweck and Reppuci (1973) reported that teachers have interacted more with boys and encouraged greater intellectual risk taking and independence than with girls. Teachers also have tended to perceive females more stereotypically (Sadker & Sadker, 1985) and have tended to give lower ratings to bright adolescent girls who displayed analytic, original abilities and were resistant to conventional approaches. Boys exhibiting the same characteristics were given higher ratings (Welsh, 1977). Boys have been more familiar with science ideas and objects and thus have spent more time than girls handling and working with science equipment in school (Kahle & Lakes, 1983). As a result of differential conditioning, Dweck (1975) found that bright girls attributed their academic success to luck and their failures to a lack of ability, while bright males attributed their success more often to ability.

The overall structure of curriculum and instructional programs may favor males. Higham and Navarre (1984) have claimed that some subjects, such as foreign language and advanced mathematics, should be offered early in the curricular sequence for girls to capitalize on their readiness instead of later on in school when males are developmentally ready. Belenky, Clinchy, Goldberger, and Tarule (1986) concluded that disciplines such as mathematics and science were designed to favor the masculine experience and analytical way of thinking. Social pressures within schools influenced females. Girls more often than boys have faced rejection by their peers for appearing too smart and for doing something unorthodox for females such as taking a summer mathematics course or an accelerated course during the school year (Fox & Richmond, 1979). Girls find few role models in a summer science museum course on rocket making.

Not only have there been fewer women scientists traditionally, but there have been fewer female science teachers at high school and college levels. Consequently, males and females have viewed scientists and the field of science as masculine, a stereotypical view that has persisted (Kahle & Matyas, 1987). The view of science as

masculine may be an internal barrier to females considering a science career.

Internal Barriers

Researchers have reported that academically talented females frequently develop negative responses to success (Fleming & Hollinger, 1984). These negative responses have constituted internal barriers for female achievers, especially in fields perceived as masculine. Females' low self-esteem and sense of conflict in their lives have been identified as internal barriers, contributing to their failure to succeed. These barriers are discussed next.

Lower self-esteem. Lower self-esteem has been experienced more often by bright females than bright males (Fleming & Hollinger, 1984; Silverman, 1986). Academically talented high school females have been found to experience underachievement, nonassertiveness, fear of success and a need for social acceptance that has prohibited their entering non-traditional careers (Fleming & Hollinger, 1984). In a study by Kramer (1985), middle school gifted girls perceived their giftedness as based on their hard work, while they viewed the skills of their male counterparts as being based on ability. The girls

perceived the cause of their achievement as rooted in effort rather than ability.

Bright females have been reported to experience a "perfection complex," that is, they believe they must be perfect in everything from their appearance and social life to their academic performance. This unrealistic set of high expectations has kept them from believing that they are able to achieve (Reis, 1987). The "imposter syndrome" (Clance, 1985; Machlowitz, 1982; Warschaw, 1985) is experienced by many bright females when they achieve high levels of success in that they attributed accomplishments to luck or to help by others, not their ability. Able females have been reported to feel a fear of success when in competition, because they fear they will been seen as less feminine if they win. This conflict is felt especially in competition with men (Horner, 1972).

Conflict. Gifted females have also felt a conflict in living up to the different expectations society has for persons who are feminine and for those who are gifted. While traditional femininity has been associated with passivity, dependence, and nurturance, the development of giftedness has been reported to require autonomy, independence, and self-development together with creative

production (Schwartz, 1980). It is difficult for bright adolescent females who want to be accepted socially by their peers, especially males, and to compete academically. Kerr (1985) concluded that because females grow to be so cheerfully compliant, adaptive and compromising, they easily put others' needs ahead of their own career development and self-actualizing needs. Meeting other's needs is a traditional female value.

Gilligan (1982) suggested that males and females have different value systems. Males have traditionally valued independence. They have had concern for rights and justice and have had the tendency to be more competitive. Females, on the other hand, have felt more of a need for connection with others. They have been more cooperative in their interactions and have made decisions based on interpersonal relationships and responsibilities to others. Farmer (1987) concluded that older female adolescents have been making decisions about their future at a time in their lives when they have valued personal interactions and have held strong social values. Their perception of science-related careers as involving individual work and social isolation with outcomes unrelated to the real world and society have caused them to reject science as a viable career path.

In summary, numerous external and internal barriers have been identified as contributing to the downward trend in the academically talented female's achievement and interest level in academic areas once she enters secondary schools. The downward trend of achievement is especially noticeable in science-related courses and activities. Females' rejection of scientific fields as viable careers has led educators to devise interventions to counteract the internal and external barriers to science careers that females appear to experience.

Interventions

Interventions are treatments planned to bring academically talented females into science and engineering by encouraging them to overcome the barriers they experience (Malcolm, 1988). Some interventions have been developed to help overcome the external and internal barriers females experience in science. One focus in interventions has been on educating educators and parents to encourage females in science while also helping girls acquire science experiences and confidence. For example, a program for young gifted females, Action Science, was designed so that girls could have direct, hands-on scientific experiences in a laboratory with science

materials and methods. In this program parents were taught to facilitate their daughters' interest in science (Rand & Gibb, 1989).

Another intervention has been the establishment of the residential science program. In 1959, a residential science program for advanced high school science students was established at the University of Florida. Academically talented students who have completed the 11th grade and a small proportion of mature students who have completed 10th grade have participated in this 8-week, intensive experience in science and engineering. The intervention was designed to include key experiences important to the development of future scientists. Scientific research, laboratory experiences with professors serving as preceptors, lectures on a variety of scientific topics, and hands-on/in-depth workshops and seminars have provided students with the essential ingredients of preparation for understanding the scientific disciplines. Career and academic guidance as well as the ongoing interaction with other students similar in talent and interests have provided the critical affective component often missing in traditional science curriculum (Belenky et al. 1986). Finally, the opportunity to interact and learn together with a research

scientist as a monitor has given students a realistic view of the scientist as a person and researcher.

The intervention was not designed specifically to overcome barriers to females entering science careers; however, it has provided hands-on laboratory experiences, role models and peer interaction with others interested in science that have been described as critical, but that are rarely available in the schools for females (Kahle & Matyas, 1987). The impact of this program on females has not been examined by researchers. It is not known whether these types of intensive science experiences motivate females to consider science fields as careers.

Statement of the Problem

There is a need to expand the talent pool of potential future scientists. Bringing more academically talented females into scientific careers is critical for the scientific community and for the advancement of society. Presently, there is a marked gap in male and female participation in the sciences. This disparity begins at early adolescence.

Researchers have identified a number of factors that have discouraged girls with scientific interests from pursuing science-related careers. Females'

science-related attitudes are not as positive as males' and actually decline as females go through school. Bright females are often more externally controlled than males. That is, they tend to attribute their successes on male-oriented tasks to luck or hard work and failures to their lack of ability (Addison, 1981). If in science, talented females are engaged in these type of attributions, the probability of maintaining their career science interest is questionable. Additionally, females do not often have the prior science-related experiences that can give them the familiarity and confidence to engage in and succeed in the sciences (Kahle & Lakes, 1983).

A type of intervention exists that provides key scientific experiences for able male and female adolescents interested in science. The intensive science treatment provides many of the essential experiences stated in the literature that females do not often have such as hands-on activities, encouragement, role modeling and intensive peer interaction through both academic and social experiences. Additionally, the contextual learning that takes place in the laboratories regarding research on real-life problems is supported both in the gender-related (Belenky et al. 1986; Gilligan, 1982) and gifted

literature (Renzulli, 1979) as fundamental to the development of potential in gifted and talented females.

The academically talented students involved in the experience have been identified as potential future scientists in need of encouragement to continue on in scientific careers. Questions have not been answered regarding the influence of the science experience on the female students' belief systems that would counteract possible barriers to pursuit of scientific careers. It is important to know whether females' attitudes toward science, and beliefs about their ability to succeed in science (science locus of control) can be enhanced through an intensive science experience. Additionally, it is not known whether female students feel more committed to pursuing science as a future career after participating in the science experience.

It is valuable to examine the impact of an intense summer science intervention on the critical variables of attitudes, locus of control, and commitment to career interest in science in academically talented females. Few studies have focused on non-school-based science interventions, and especially for this particular population (Cronin, personal communication, May, 1989).

Purpose

The purpose of the study was to determine whether an intensive science experience affected academically talented female adolescents positively as compared to males. The three areas of concern were (a) science-related attitudes, (b) science locus of control, and (c) commitment to a science career. Also of interest were gender differences in students' prior science-related hands-on and encouragement experiences before the treatment.

Research Questions

1. Among students who have been identified as academically talented, is there a difference before the summer science intervention by gender in respect to

   a.) science-related attitudes,

   b.) science locus of control,

   c.) commitment to a science career, and

   d.) prior science-related experiences?

2. After completion of an intensive science intervention program, are there significant differences in academically talented students by gender in respect to

   a.) science-related attitudes,

   b.) science locus of control, and

   c.) commitment to a science career?

Significance of the Study

Gifted females are not participating in science to the same degree as males by the time they reach high school because of a number of internal and external barriers. Interventions are needed to reduce barriers so that academically talented females can be encouraged to choose scientific careers for the sake of developing their potential as well as to benefit the scientific community. Positive science-related attitudes, internal locus of control in science, and commitment and motivation to continue in science are precursors to pursuing a career in science (Kahle & Matyas, 1987; Malcolm, 1988; Simpson & Troost, 1985). Understanding the impact of an intensive, summer science experience in late adolescence on males and females' career development in science could provide invaluable insight into how educators can help motivate underrepresented females to pursue a career in the science-related fields. Through an influential experience such as this one, females can learn to overcome sex stereotyping and develop their talent in science. An intensive program may also promote equal opportunity for women in the sciences at the local and national levels by increasing the number of women entering the national scientific talent pool.

Definition of Terms

Academically talented students in this study are those who have a composite academic record of at least a B+ grade point average, score above the 500 level on the PSAT in mathematics, and are nominated as academically talented in science by school personnel.

Commitment to a science career refers to the motivation and clarity a student indicates by stating personal goals for a science career.

Intensive science experience is an 8-week residential science summer experience at the University of Florida that has two major components: (a) laboratory and academic research participation, and (b) orientation to science and engineering fields. Each component emphasizes key scientific experiences for the training of future scientists.

Prior science-related experiences include both hands-on and encouragement experiences. Hands-on refers to toys played with, science activities in school, building something that worked, and science fair participation. Encouragement refers to positive, influential support from significant people during a student's period of development.

Science refers to all related areas of science based on chemistry, physics, and earth and life sciences. Included in the related areas are engineering and health-related sciences.

Science locus of control orientation refers to beliefs people hold regarding their personal efficacy or ability to influence the outcome of events in situations where decisions or actions require either the application of scientific knowledge or the use of reasoning skills associated with scientific thinking (Haudry, 1985).

Science-related attitudes as measured by the Test of Science-Related Attitudes (TOSRA) (Fraser, 1978), and Science Attitudes Survey (Matyas, 1985) have been defined as students' views of and acceptance of science as well as students' positive experiences in and feelings towards science. Areas of focus include scientists as normal people, women in science as acceptable, social implications of science, and scientific inquiry as an acceptable thought process. Positive science experiences in and feelings towards science involve enjoyable experiences, confidence in science, perceptions of teachers as having confidence in abilities, feeling successful in science and having been encouraged by parents in science.

Limitations

The study has several limitations to generalization. First, the sample is limited in geographic representation to the state of Florida and within Florida. There is not equal representation based on regional population trends from the different regions in Florida. The sample includes only rising 11th and 12th grade students. Therefore, the findings of the study will be limited to older adolescents with a strong interest in science who are academically talented, as indicated by their high PSAT scores and high grade point averages in math and science.

The study is also limited by the instruments used. The instruments are new and lack extensive reliability and validity data. Additionally, they are self-report instruments which may reflect the biases of students' self-perceptions.

Summary

It is important to encourage academically talented females interested in science to choose scientific careers. External and internal barriers contribute to females' negative perceptions of science as a career. Educational interventions exist that were planned to encourage students to pursue scientific careers. This

study was designed to investigate the effect of an intensive science experience on the personal valuing of science in bright female adolescents.

A review of the literature related to this study is presented in Chapter II. Methodology of the study is discussed in Chapter III. The results of the study and the implications are covered in Chapters IV and V.

CHAPTER II
REVIEW OF THE LITERATURE

In this chapter, a summary and an analysis of the professional literature involving the problem addressed in this study, the impact of an intensive science experience on the science attitudes, locus of control, and career commitment of academically talented high school males and females is presented. The chapter is divided into nine major sections: selection of the literature, overview of the literature, career development, need for female scientists, factors in underachievement of academically talented females, science interventions, science-related attitudes, locus of control, and commitment to a career in science. Selection criteria for the literature that was reviewed and an overview of the importance of related literature are presented. Included in the overview is a discussion of the lack of pertinent literature related to science programs for gifted and talented females. In the subsequent sections, a synopsis of the related literature of each variable was discussed. The chapter concludes with a summary and implications of previous research as it relates to the present study.

Selection of Relevant Literature

An initial step in the review of the literature was that of determining the criteria for the inclusion of references. All relevant studies completed in the last nine years (1980-1989) were examined. In addition, any notable research cited in the literature earlier than the 1980s was also considered.

Three major bodies of the professional literature were examined. The gifted and talented literature that focused on gifted females was covered. Also reviewed was developmental gender differences in the general population. The science education literature was investigated as well to determine the factors associated with females and science.

In order to carry out an exhaustive review of the literature relating to gifted and talented adolescent females in science and the variables of programs, attitudes, locus of control and career commitment in science, the following sources were included: Dissertation Abstracts International, Educational Resources Information Clearinghouse (ERIC), Psychological Abstracts, and Current Index to Journals in Education (CIJE). Additionally, the two major journals in science education were reviewed: Science Education and Journal of Research in Science

Teaching. In addition, the three major journals in gifted education were reviewed: Gifted Child Quarterly, Roeper Review, and Journal for Education of the Gifted. References initially selected were located at the University of Florida library, through the interlibrary loan system, and through direct contact with key researchers in the field of women in science, science attitudes, and locus of control in science. Descriptors used in this literature search included gifted and talented adolescent females, science, science programs, career development, attitudes, self-concept, locus of control, attributions, and achievement motivation.

The references that were selected were reviewed critically, and those that described empirical investigations were chosen based on the investigator's judgement that the references presented a clear description of subject selection, methodology, and results. Professional literature other than empirical investigations was also included if, in the author's judgement, the information that was included provided a valuable contribution to the knowledge base about or an understanding of gifted and talented females in science, or the general population of females in science.

Overview

The problem addressed in this study, the influence of an intensive science experience on the science attitudes, locus of control and career commitment of high school talented males and females, and gender differences in science-related experiences prior to the intensive experience has not been previously investigated, although researchers have studied general factors associated with the underachievement of gifted and talented females. Also reported in the literature are factors that relate to the underrepresentation of females in the general population in science education. Studies of science attitudes and locus of control have been primarily concerned with the general adolescent population. Few science interventions for gifted and talented adolescents have been examined in the literature. The available literature most closely related to this problem was chosen for review and discussion: career development of females--gifted and talented females in particular--and the factors associated with science-related career choice, the need for more women in science fields, science interventions, science attitudes, locus of control--particularly in science--and commitment to science as a career option. The chapter concludes with a

summary and implications of previous research as it applies to the present study.

Career Development

Career development was conceptualized by Super (1957) as a process in which individuals strive to develop their self-concepts by choosing to enter the occupation they see as most likely to permit them self-expression. Super also suggested that the specific behaviors people engage in to implement their self-concepts vocationally are a function of the individual's stage in life development.

Although Super's primary work is based on the four types of career patterns found in men, he is one of the few career theorists who has acknowledged that women's developmental career patterns were different from those of men. In 1957, Super based his theory of the seven career patterns of women upon the life stages theory of Buehler (1933) and the career patterns research of Miller and Form (1949). Buehler had identified five stages in life and established the ages of persons in each stage. He considered the ages to be approximate and the activities engaged in at each stage to be varied in different persons' lives. The activities were shared by males and females.

Form and Miller (1949) based their classification of work periods upon a study of work histories of a sample of men. They utilized the concept of life stages to make their description of job sequences meaningful. They found five classifications: preparatory work period, initial work period, trial work period, stable work period, and retirement period.

Super simplified the list to four to avoid duplication. He pointed out that females differed significantly from males in their career patterns, both in number of patterns, seven rather than four, and in the variations within the patterns both males and females followed. The differences were accounted for by biological, psychological, and social factors relating to females' experiences as wives and mothers, and as job-holders. Super discussed the importance of carrying out additional research into the special needs of females for career guidance. He commented that more and more women would enter the job market.

Women have entered the job market in increasing numbers. They have not, however, entered the scientific fields to the same degree. In attempting to piece together a picture of how various factors have interacted in females' decisions to participate or not participate in

science, Chipman and Thomas (1987) proposed a dynamic model based on the theoretical approach that others (Casserly & Rock, 1983; Eccles-Parsons, Adler, Fittlerman, Goff, Kaczala, Meece, & Midgley, 1983; Lantz & Smith, 1981) had taken to understand the case of female participation in high school math courses. Chipman and Thomas suggested two major factors that contribute to the outcome of participation in science-related careers: expectancy of success and value assigned to outcome. Each of these factors is affected by many other elements.

Expectancy of success is likely to be influenced by such elements as cognitive ability in which there are individual differences and in which some claim there are relevant sex differences (Benbow & Stanley, 1980). Also affecting expectancy of success is self-perceived ability, another area in which sex differences also are found. Other influences include attribution process, prior achievements and difficulties, social stereotypes of capacity, and expectations of others.

The value of participation in a particular field of endeavor is also related to many influences in the environment. Immediate reinforcement or lack of reinforcement for participation in a particular field may be important. It can come from parental encouragement, the

expression of negative attitudes by male peers, or generally prevalent stereotypes of science as a suitable career for a female. Anticipation of future family-career conflict ties in to the view of science as an inappropriate career for women. Also related are the large sex differences in interest patterns that clearly influence the perceived value of career and courses of study, and that have substantial effects upon the selection of scientific careers. The large sex differences in interest patterns can account for much of the sex differences in career selection (Dunteman, G. H., Wisenbaker, J., & Taylor, M. C., 1979). According to Chipman and Thomas (1987), research to date has not demonstrated that the majority of the variables associated with sex differences in cognitive ability are related to the scientific career choices by females. In contrast, the interest patterns--such as the relative interest in things versus people--are significant predictors for individuals and provide for some of the observed sex differences in choice of science courses and career participation. Chipman and Thomas suggested that more research in interest development is warranted. Confidence in ability may also provide some of the explanation for the observed sex differences in participation. Confidence in ability varies somewhat from

actual ability especially in females. Interventions that focus on the variables of interest and confidence may provide the significant effects needed to encourage more females to enter science careers.

A reported dilemma in the career development of the gifted and talented student is the issue of multipotentiality (Colangelo & Zaffran, 1979; Perrone & Male, 1981; Sanborn, 1979). It has been defined as the ability to select and develop any number of career options (Frederickson, 1979). Gifted and talented adolescents who are high achievers have been found to have difficulty selecting among many career possibilities (Sanborn, 1979). Throughout high school and college, career counseling for gifted students often has resulted in counselors remarking to gifted students that they can be anything they want to be--and this is precisely the problem for many in this population (Kerr, 1983). Too many options and not enough guidance can lead to delay of career decision making, multiple changes of major in college, and even a lack of direction in adulthood, as Kaufman (1983) found in her follow-up study of presidential scholars.

The gifted and talented female who has interest and talent in science-related areas may not choose a career in the field of science unless provided with appropriate

interventions that emphasize values and lifestyles (Kerr, 1983). Because gifted and talented students have the capability to succeed in a variety of careers, bright females need specific interventions that address the value of choosing science as a viable career option.

Interventions are especially needed at critical points for career decision making. According to Widnall (1988), differential attrition in the science pipeline between males and females occurs at two points, near the beginning of college and in graduate school. Fewer women than men choose to major in science in college. Relatively more women than men drop out of graduate school before completing a Ph.D. Widnall concluded that if more women are to be encouraged to enter scientific careers, efforts must be focused on the time of the initial career choice and how to keep women in graduate school. The exploratory stage proposed by Super (1957) in the latter part of adolescence at approximately 11th and 12th grade, into the beginning of college, is a critical time for influencing career decisions for females.

Need for More Female Scientists

As reported in the Interim Report by the federally commissioned Task Force on Women, Minorities, and the

Handicapped in Science and Technology (1988), women are 51% of the population and 45% of the Nation's workforce, yet comprise only 15% of all employed scientists and engineers. In 1986 women earned 30% of the bachelor's degrees in science and engineering. Within the field of science, they earned 34% of the Ph.D.s in the life sciences, but only 16% of the Ph.D.s in physical sciences and 7% in engineering.

It was stated in the report that even though women have made considerable career gains recently, they have not been choosing careers in science and engineering in the same proportions as in the nonscientific professional, business, and management areas. Women who do enter the scientific workforce have been paid less and promoted less often than white men. In 1985, women were only 13% of all college and university faculty and 2% of engineering faculty. They have been twice as likely as men to be in non-tenure tracks.

Two problems have been stated as factors related to women completing advanced degrees and moving forward in science careers. First, in graduate school, fewer women than men who initially plan to complete a Ph.D. in the science fields actually do complete the degree. This may be due to the fact that women have been more likely than men to be self-supporting during that period. They have

also been more likely to be assigned to teaching assistantships where they have dealt with students, instead of research assistantships where they worked with peers and mentors. Secondly, during their 20s and 30s when women scientists were finding their career demands the greatest, they are also involved in making decisions about childbearing.

Wills (1989) argued from the perspective of three different contexts for including more women in science. First, the Federal Government is interested in encouraging more women to enter the sciences to increase the United States' talent pool of scientists. There are fewer white males entering scientific fields. United States citizens now constitute a minority in most science and engineering graduate programs. Overseas students have become the majority in scientific training programs. To increase the pool, United States' females must be recruited. Secondly, Wills contended that science is a valuable career for women, especially for those who are research scientists at universities. She stated that work time can be flexible and adjusted for family needs, and researching scientific ideas is exciting intellectual activity. Wills' third argument was that science needs women. Females bring a different perspective to the knowledge base and to research

methods. For example, in third world agricultural research projects, there are many cases when female researchers have the advantage over men in gathering data from the workers in the fields--women. Also, for example, a feminist perspective on evolution can offer invaluable insights often overlooked by male scientists. Thus, women's perspectives can contribute significantly to the sciences.

Unfortunately, women's contributions are lacking because they are not choosing to be scientists. Many factors have been reported to contribute to the decisions made by able women not to enter scientific fields. These factors are linked to the personal, social, and educational development of academically talented females beginning at a young age (Matyas, 1985).

Academically Talented/Gifted Females

Researchers have noted the disinclination of academically talented and gifted females to succeed. The failure to achieve has been especially notable in math and science.

Characteristics of Gifted and Talented Females

Gifted and talented females have been regarded as a special population in contrast to gifted males due to what

appears to be the loss of their giftedness over time. According to Callahan (1979, p.402), "Even though females may earn higher grades in school and possess equal intelligence, in adulthood men write more books, earn more degrees, produce more works of art and make more contributions in all professional fields." According to definitions of giftedness, gifted students possess high potential. As they grow, they are able to develop gifted behavior if encouraged through appropriate environmental conditions. In adulthood they are able to then manifest that ability as achievement (Renzulli, 1979). As children, males and females have participated equally in gifted programs, but by high school more males have participated in gifted programs (Silverman, 1986). In adulthood, men have far outnumbered women in positions of eminence and creative productivity (Reis & Callahan, 1989).

Although gifted females are considered to be different than their male counterparts (Callahan, 1979; Fox, 1979; Kaufman, 1981; Kerr, 1985; Reis & Callahan, 1989), they have not received much attention in the research literature. In the history of gifted education so little attention has been directed toward the gifted female that Fox (1978) commented; "I wonder...how many written articles or presented papers on the topic 'The Gifted Child' would

have been more realistically entitled, 'The Gifted Male' (p. 114). Reis and Callahan (1989) concluded that perhaps the accepted definitions of and resulting programs developed for gifted and talented students do not consider the characteristics of gifted females.

Major studies regarding the development of the gifted person have served as the foundation for the definitions. According to Reis and Callahan (1989), these major studies have been primarily studies of males. For instance, the Structure of the Intellect Model (Guilford, 1959) was developed from research on male army recruits during World War II. Kohlberg's theory of moral development was based on a male population only, and was subsequently challenged by Gilligan (1982) who then developed a model for female moral development.

Renzulli (1979) described the gifted as possessing three interlocking traits: above-average ability, creativity, and task-commitment. He derived his widely accepted definition from research on eminent people in society who were male. His educational model, based on his definition of gifted people, emphasized learning the framework and methodologies of the disciplines and applying them to real-life learning experiences. Reis and Callahan (1989) questioned the appropriateness of Renzulli's model

for both males and females because the framework is based on theories developed by males. They suggested that adaptions are needed to accommodate the different orientation of females.

Also emphasized in the gifted curriculum is independent study as in the case of the Autonomous Learner Model (Betts & Niehart, 1986). Autonomous, independent learning has been found to be a preferred learning model for males but not for females (Belenky et al., 1986). Female teachers may use more varied instructional methods. Fox (1978) stated that young girls do better in mathematics if they have a female teacher and are in mostly female classes. Unfortunately, girls do not have female role models often in science and math. Overall, the developmental differences and orientations of gifted females are not taken into consideration in instructional programming.

Belenky et al. (1986) concluded that the model of intellectual development is clearly masculine. The mental processes involved in the abstract and impersonal have been labeled "thinking" and are usually attributed to men. On the other hand, mental processes that involve the personal and interpersonal fall in the category of "emotions" and are relegated to women.

In the context of male-oriented definitions and gifted programs, the gifted female is characterized as being different than her male counterpart, and different from average females. Defining who the gifted female is has been difficult. The achievement profile for gifted females tends to decrease during schooling, whereas the academic profiles for males and especially gifted males increase during this time (Silverman, 1986). Although gifted females' grades are usually higher than those of males, their standardized test scores in high school are slightly lower, primarily in mathematics and science. Their career aspirations are clearly lower than those of males, especially in the latter part of high school and in college (Kaufman, 1981; Kerr, 1985).

Barriers Gifted and Talented Females Experience

Blaubergs (1980), Hollinger and Fleming (1984), and Kerr (1985), are among researchers who attributed gifted females' downward trend in achievement and aspirations to external and internal barriers that gifted and talented females encounter in their personal and academic development. These barriers appear to have a major effect on the realization of potential--or giftedness--in bright females. Many able females may not have recognized or

accepted their giftedness during school years, and some never recognize their abilities (Noble, 1987).

External barriers. Bright females experience obstacles that originate in the family, school and society. Traditional sex-role conditioning begins early when little girls are held close and boys are encouraged to explore their environment (Block, 1984). In a study by Rheinbold and Cook (1975), the rooms of girls between the ages of 1 and 6 were found to contain more dolls, doll houses and domestic toys, while boys' rooms contained more vehicles, education-art materials, spatial-temporal toys, sports equipment, toy animals, depots, machines, fauna and military toys, and more toys in general. Researchers reported that when 18 month old girls were given the opportunity, they spent as much time playing with vehicles and objects as did boys. Casserly's observations of gifted adolescent girls' recollections (cited in Fox, 1978) indicated that even though some gifted girls preferred 'male toys', they were not given these toys as young children. Gifted girls who took advanced placement courses in science and mathematics in high school reported their early frustration in trying to get chemistry or construction sets as toys: "...Girls lamented the fact that parents seemed to fear that the girls would hurt

themselves with a chemistry set, yet did not fear that the girls would hurt themselves in the kitchen." (Casserly, as cited in Fox, 1978, p. 117)

In schools as in homes, females have experienced differential treatment. In a recent study boys were found to dominate the classroom vocally (Sadker & Sadker, 1985). In more than a hundred 4th, 5th, and 6th grade classes in four states and the District of Columbia, Sadker and Sadker found that boys have received more attention and encouragement from teachers than females. Teachers have been found to respond differently to males and females who have called out in class without raising their hand. When boys called out to respond to a question, the teachers accepted their answers. Girls who called out received negative responses from their teachers. The Sadkers (1985) claimed their research has identified subtle messages taking place in the classroom: "Boys should be academically assertive and grab teacher attention; girls should act like ladies and keep quiet." (p.56)

During their years in school, bright girls have encountered fewer positive same-sex role models that have helped to expand their awareness of the options possible for females. Many classic children's stories present females as incapable of risk-taking behavior or of pursuing

a variety of career options beyond mother, queen, and wife. Text books continue to show more examples of males in assertive and adventurous activities while females are portrayed as dependent and docile (Kahle & Matyas, 1987). Women's contributions to history have still not been acknowledged fully and often the literature studied in English classes is focused on the adolescent themes experienced more often by males (Gilligan, 1982).

Fox (1978) suggested that willingness to participate in subject-matter acceleration may be a function of a sex-by-subject-area interaction. In fact it may be a three-way interaction of sex, age and subject matter. It is based on the fact that more boys have been interested in participating in The Study of Mathematically Precocious Youth (SMPY) program at Johns Hopkins. Additionally, according to the data from the Advanced Placement Program, participation by females in optional non-mathematical or non-science related programs is far greater than their participation in optional science and math programs.

Bright females are exposed daily to sex-role stereotyping in society. Magazines, television, and movies continue to portray sexual stereotypes. Although improvements have been made in the last decade (Reis, 1987), men have continued to be portrayed as adventurous,

risk-taking and dominant while women are more often shown as passive caretakers of home and family. Reis (1987) pointed out the example of an advertisement from a "progressive" magazine that features an advertisement on the back cover depicting a man using a telescope (caption--"He likes the planets.") and a woman looking at a book about Hollywood (caption--"She likes the stars."). Images of this type provide stereotypical messages to bright young girls about their expected role in life.

The external messages gifted and talented females receive from home, school and society have been postulated to result in girls' confusion about appropriate behavior. There has been a conflict for girls in being intelligent and being female. An alert and inquisitive mind may cause a bright student to call out in class, to debate, and to challenge. A young boy who does this may be labeled quick, assertive, motivated or scholarly while a bright young girl who asks too many questions may be labeled obnoxious, aggressive, pushy or unfeminine (Rodenstein & Glickauf-Hughes, 1979; Schwartz, 1980).

Internal barriers. Various theories have been proposed to explain the psychological factors underlying gifted women's failure to achieve to the same degree as men. The literature regarding gifted females has focused

on the low self-esteem and the conflict of being both gifted and female.

Fear of success was a concept developed by Horner (1972) to explain the tendency of women to underachieve when in competition with men and to perceive success negatively. A number of studies with a variety of formats documented by Horner's colleagues have all concluded that some form of fear of success in women, including groups of bright women, does exist. Clance (1985) developed what was labeled the "Imposter Phenomenon" to account for the tendency of gifted women to express the fear of being found out--of someone discovering that they are not really bright or competent. Bright females have learned to doubt their own abilities in the absence of clear, direct reinforcement for accomplishment.

Gifted females have often been faced with the conflicting expectations of being both female and gifted (Fox & Tobin, 1978; Ruth & Richards, 1974; Schwartz, 1980; Wolleat, 1979). On the one hand women have been expected to fulfill a supportive and nurturant role while on the other hand the gifted have been expected to develop their own talents (Schwartz, 1980). Women have been expected traditionally to be responsible for the home and family while the gifted have been expected to pursue meaningful

careers (Schwartz, 1980). The dualistic roles imposed upon gifted females have resulted in girls frequently receiving conflicting messages regarding career aspirations. Gifted girls have been rewarded for good performance in school, but have been taught by parents, teachers, textbooks and the media that intellectual pursuits are unfeminine (Ruth & Richards, 1974). These expectations in many cases have been internalized and have resulted in an uncertainty regarding appropriate roles and behaviors (Reis, 1986).

Another source of conflict has been the differences in the psychological orientations of males and females. Gilligan (1982) found that males and females function in different value systems. Females have viewed moral concerns in terms of interpersonal relationships and responsibilities to others, and as a result may have had difficulty putting their own needs in front of the needs of those they care about. They have tended to make decisions based on an ethics of caring and responsibility for others while males have based their decisions on individual rights.

Gilligan (1982) described how as women develop, they have moral problems resulting from conflicting responsibilities. In her research Gilligan discovered a type of thinking in her female subjects that was contextual

and narrative rather than the traditionally male-oriented, formal, and abstract mode of thought. Other striking gender differences were found in the ways males and females perceived intimacy and competitive success. Whereas men were more afraid of intimacy than achievement, women tended to be more afraid of achievement than intimacy. Women's identity also appeared to be tied up in their need to make and maintain a network of relationships. Women reported that it was difficult to think about themselves without thinking about the needs of other people around them.

In contrast to the classic theory of human development advanced by Erickson (1968) who portrayed female differences from males as deviant or mysterious, Gilligan has concluded that each sex has a qualitatively separate orientation. Females are guided by their sense of connection and their responsibility and care for others while for males, separation and individual rights are an underlying orientation. Gifted and talented females' underachievement in school may be the result of an inappropriate school curriculum and environment.

The gifted female has had the most to lose in an educational system possibly based on a male model of thinking and development (Shakeshaft, 1986). The conflicts gifted females have tended to experience may have arisen

from the notion that 'success' and 'achievement' have been defined in the male experience and male model of thinking as proposed by Gilligan (1982). Shakeshaft (1986) has proposed that if schools had placed more emphasis on the female orientation as defined by Gilligan, then more females may have been able to develop more of their natural abilities.

In summary, gifted and talented females have tended to experience barriers that have prevented them from believing in their capabilities and living out their potential as able, creative productive people who can contribute significantly to society. Females have experienced difficulties in resolving the conflict of society's expectations in relation to their being both gifted and female, and in maintaining the motivation to pursue their talents, especially in the non-traditional field of science. These conflicts contribute to their underachievement.

Factors Related to Females' Underachievement in Science

Between the ages of 9 and 14, girls' science achievement declines and their interest in science wanes (Malcolm, 1988). During high school girls do not elect to take science and mathematics courses as often as their male

peers, and males outscore females in science and mathematics on Scholastic Aptitude Tests (SAT). Factors exist that significantly affect young women's science education as well as entry into scientific careers. Three groups of factors have been isolated by science education researchers: educational, sociocultural, and personal factors.

Educational Factors

Males and females have not received the same science education within the environment of the classroom (Kahle & Lakes, 1983; Skolnick, Langbort, & Day, 1982). In the 1976-77 National Assessment of Educational Progress (NAEP) survey it was reported that as early as age 13, girls' achievement in science was lower than boys' and their attitudes toward science were less positive than males. Girls had participated in far fewer science activities than males (Kahle & Lakes, 1983). In an international study, Kelly (1984) explored the relationship between science attitudes and science achievement in 19 countries. It was found that students with positive attitudes toward science tended to achieve more in science than students with less positive attitudes. Attitudes in science were

significantly related to science achievement even when ability was controlled.

To determine the cause of achievement and attitudinal difference, two kinds of questions were asked in the NAEP survey. One type of question related to the actual number of science experiences the students had experienced, and the second type of question referred to the students' desire to participate in science experiences. The questions were designed to assess whether girls' lack of scientific experiences was related to lack of interest or lack of opportunity. As a result, at age 9, even though girls expressed interest in many science activities, the actual number of activities they participated in were significantly less than what the boys had experienced. Between 9 and 13, girls' desire to participate in science activities diminished. This decline paralleled a decline in science achievement levels and in science experiences of females between 9, 13, and 17 years of age. Consequently, by the time females have entered high school, they have had fewer science experiences than males with instruments and materials, and have obtained lower scores on achievement tests in science and mathematics than males (Matyas, 1984).

By the time boys and girls were 13 years of age, disparities existed in their extra-curricular science

experiences. Females engaged less often than their male peers in activities such as reading science articles and books, watching scientific television shows, and doing science projects and hobbies. Females visited far fewer places on science field trips outside of school than males. Play experiences related to mathematics and science preparation were also disproportionate. Males and females were given different toys. Boys' toys emphasized relationships with objects -- manipulating, grouping, taking apart and rebuilding objects. Girls' activities were more closely associated with verbal and interpersonal skills (Skolnick et al., 1982).

Sociocultural Factors

Sex-role stereotyping is stated by researchers as one of the major reasons for females not choosing to go into science. Girls view science careers as masculine and so choose not to enter scientific fields. Vockell and Lobonc (1981) in testing these assumptions found that high school females rated science careers as masculine, especially physical science careers. This stereotyping was found by the same researchers in children as early as kindergarten.

Characteristics of females have not been regarded as consistent with the characteristics of scientists. In a

study by Broverman, Vogel, Broverman, Clarkson and Rosenkrantz (1970), female attributes were described by adjectives such as gentleness, quietness, emotionality, passivity, dependence and subjectivity. Men, on the other hand, were described as possessing aggressiveness, dominance, rationality, independence and objectivity, the traits that have been associated with science (Broverman et al., 1972).

Further studies of the characteristics of scientists found that their traits are associated with masculinity. Characteristics identified have been high intellectual ability, persistence at work, extreme independence, and "apartness" from others (Rossi, 1965 after Roe, 1953). Girls have not been socialized in ways that have developed scientific traits and ways of thinking. They have not been encouraged to use their practical ability, to be independent and to build their self-confidence. Rossi (1965) stated that women would be able to become scientists when they developed the analytic and mathematical abilities that science requires. Parents and teachers need to encourage them to be independent and self-reliant instead of pleasing and submissive. Girls' efforts to satisfy their curiosity about the world need to be reinforced.

Therefore, girls need to be encouraged to be alert and inquisitive.

Personal Factors

Another major factor related to the underachievement of females in science has been lack of self-confidence (Hollinger & Fleming, 1984). Females have often felt they must be better than males to be considered equal in male dominated areas. When males have had difficulties, they have tended to place the responsibility for the problems outside themselves, whereas women have placed the blame internally (Reyes & Padilla, 1985). Dweck, Davidson, Nelson, and Enna (1978) explored sex differences in learned helplessness and found that teachers and students attributed negative evaluations of males to nonintellectual factors. On the other hand, the negative evaluation of females was attributed to intellectual deficiencies. These type of attributions have given females the clear message that they have not been intellectually capable.

In summary, to increase the participation of females in science, researchers must obtain knowledge of the factors that underlie students' interest in and attitudes toward science and math. For example, in a survey of 2,046 junior and senior college students majoring in mathematics

or science, factors that influenced students' interests and decision to major in these areas were assessed. The research employed multiple regression analysis as a method for identifying the factors. The results confirmed the numerous factors described in studies previously cited. The factors included interest in childhood science hobbies, childhood aspirations of being a scientist, receiving encouragement by significant others to pursue mathematics and science majors, good high school math and science grades, and participation in high school science clubs. Early interest in science hobbies was especially important for cultivating science interest in females (Thomas, 1986).

With knowledge of at least some of the factors related to the underachievement of females established in the literature, educators are developing appropriate interventions aimed at encouraging academically talented females to enter science. Interventions that are influential in maintaining female interest and motivation in science need to take into consideration the factors that have been discussed. They included educational science experiences, sociocultural perceptions, and personal characteristics.

Science Interventions

According to Kremer (1984), educational interventions generally have had two purposes. One has been to change the behavior of the student so that maximum benefit can be gained from the educational system. The second purpose has been to alter the system to adapt to students who have special needs. As such, educational interventions can be influential in providing female students opportunities to make important changes in the attitudes and behaviors that might have kept them from pursuing studies in the sciences.

As discussed previously, important key factors encourage females to remain interested in science. Interventions have been developed that have included hands-on science activities, peer interaction with other high ability students who have similar interests in science, interaction with science role models, career awareness and education, exposure to different topics in science, research skills in science, and gender-free experiences. Some educational strategies and experiences have been investigated to determine whether a positive impact can be made on female students. Strategies have been developed for the general population of students (Matyas, 1988) and are beginning to be developed for the academically talented population.

In a study of effective strategies used by teachers, Kahle (1985) found particular methods commonly used by teachers who taught successful female students in science. In this study the successful teachers' methods of instruction had a differential, positive impact on female students. The teachers maintained stimulating and attractive classrooms, used non-sexist instructional materials and had an awareness of sexism that led them to bring female scientists into the classroom and provide a wide range of career information. Additionally, the teachers participated in and encouraged students to become involved in extra-curricular science activities. Science careers and further education were emphasized and instructional techniques employed that encouraged creativity, further education, and basic skill development. Overall, the effective teaching behaviors and techniques found were use of laboratory and discussion activities, provision of career information, direct involvement of girls in science activities, provision of informal academic counseling, and demonstration of unisex treatment in science classrooms (Kahle, 1985).

Short-term conferences for nurturing girls' interest in science and mathematics courses and for considering careers in science are another type of intervention that

has been employed to encourage girls in science. The conferences have taken place on college and university campuses and have been attended by middle and high school girls. Workshops at the conferences have been offered to promote role model interaction, career awareness information, and hands-on activities (Wallace, 1989). The conferences have had a positive impact on the participants according to a reported increased interest in science and mathematics assessed in a longitudinal study of conference participants (Davis & Humphreys, 1983). Conferences have been beneficial, but have provided a limited intervention . It may be the best available option in communities where limited awareness and resources have kept school science programs from further development.

Intervention programs developed to encourage the participation of females in science should be available for both secondary-school and college level females. A study was conducted by Gardner (1986) to evaluate intervention strategies at both educational levels. The secondary intervention program included gender-free resource materials and instructional techniques and presentations by female science-career role models. These strategies increased student perceptions that science careers are appropriate for females. It was recommended by the

researcher, however, that future development of interventions be more relevant to students' lives.

The effectiveness of a career-planning seminar for college women in nursing, biology and engineering major programs was evaluated. A comparison of biology and engineering majors who had and had not completed the seminar indicated that the course was somewhat effective for increasing career commitment among women in biology. Both biology and engineering students felt that the course helped develop their career plans, feelings of peer support, and the idea that having a family and career is possible (Gardner, 1986).

A study was made of successful high school mathematics and science advanced placement programs for academically talented females (Casserly, 1979). The three conclusions were: a) homogeneous grouping, as in advanced placement, gives students appropriate pace and sense of company along the way and provides stimulus and preparation toward professional careers in science and mathematics; b) advanced placement teachers in mathematics, chemistry and physics are excellent people for recruiting girls into those fields; c) effective college and career counseling takes place in these classes; and d) older girls in advanced placement classes can be helpful in encouraging

younger girls to maintain studies in mathematics and science.

Despite the recent development and implementation of summer programs for academically talented and gifted students, few studies have been reported, especially for science programs, that document the effects of the programs on participants, especially at the high school level. One study was conducted during the Summer Gifted Students Institute for middle school male and female students (Hansen & Hall, 1985). The purpose of the study was to investigate the relationship between two groups of students in a differentiated program for gifted students and the self-concepts of participating gifted students. One group of students commuted to campus and one group lived in campus apartments. The study involved a pretest-posttest design to measure levels of self-concept. Program courses included computer programming, geology, literature, and the dynamics of flight. Recreational activities were planned to provide students with opportunities for increasing their sense of belonging. The greatest gains in self-concept were made by the residential students. This group was able to form deeper relationships with peers similar to themselves. The researchers concluded that homogeneously grouped gifted participants in a two-week program did

experience significant improvements in self-concept. Gender differences, however, were not investigated (Hansen & Hall, 1985).

Researchers in another study investigated a university-based summer residential program and a science center-based commuter summer program. The programs were designed for academically talented male and female students, 11 to 15 years of age. Changes in self-perceptions of competence were measured prior to, at the beginning and at the end of both programs. Results indicated that social acceptance measures increased in both programs for males and females. Both programs, but especially the university-based program, placed students among others who were perceived by the students as more similar to themselves in certain aspects. This perceived homogeniety, according to the researchers, may have caused the individual's self-evaluations to be more positive after the program than prior to the program (Olszewski, Kulieke, & Willis, 1987).

Another intervention is an intensive science experience leased on the University of Florida campus, The Student Science Training Program (SSTP), originated in 1959 as a funded program by the National Science Foundation. SSTP was developed to offer academically talented high

school science students opportunities for intensive, advanced study in the sciences at colleges and universities during the summer. Minimal evaluations have been conducted on individual SSTP programs to determine the impact on students' continuation in the sciences.

One study of an SSTP experience was conducted at Syracuse University. The purpose of the study was to determine the long-term effects of the experience on the careers of participants from 1961 to 1974. The Syracuse SSTP experience was to offer students advanced science experiences in research, to expand students' knowledge of science in society, and to provide students with additional awareness of their own abilities in science.

Student participant alumni were surveyed regarding their career development and the influence of SSTP on their lives and careers. Most of the participants who responded were successful professionals. The SSTP alumni felt that the experience of SSTP had a positive influence on their academic, personal and social lives. They reported that the program had effected their decisions to continue in science (Druger & Borgstede, 1984).

Researchers studying the Syracuse SSTP project did not investigate gender differences or investigate specific variables. To date, researchers have not investigated the

impact of intensive science residential programs on females specifically. There have been no studies shown by research to encourage academically talented females to overcome the barriers that discourage women from pursuing science studies.

The SSTP intervention located at the University of Florida has also not been investigated to assess the impact of the intensive science experience on participants regarding positive influences on attitudes and career interests. The intervention incorporates many of the critical experiences essential to the development of future scientists. A major component is the laboratory and academic research participation (See Appendix A). Each student is placed with a professor who is engaged in a research area that is of interest to the student. The professor serves as a mentor to the student providing guidance, expertise and role modeling in the development of a research project. Students work 25 hours per week in a laboratory setting, becoming familiar with the sophisticated laboratory equipment and the meaning of scientific research.

Students engage also in a second component in which they participate in various activities that provide an orientation to science and engineering fields. A lecture

series by eminent scientists at the University covers many scientific topic areas. Classes in statistics or computer programming give students the tools to analyze data. Fieldtrips provide exposure to the science areas while offering structured peer interaction. Seminars and workshops on a variety of topics and issues furnish students with hands-on or in-depth experiences. Students engage in career awareness through counseling sessions and visitation to various centers and departments on campus. Peer study groups contribute to the intensive peer interaction experience. Students share their research projects with others who have similar interests and communicate about other scientific as well as personal issues in small groups under the guidance of counselors who are alumni of the program. Student interaction also is facilitated through dormitory living as well as scheduled recreational and social activities.

The intervention was not designed specifically to overcome barriers that females may experience in choosing science careers. It does, however, supply hands-on experiences, role models, and peer interactions that have been described as critical experiences for females (Kahle & Matyas, 1987). Investigating the impact of this intensive summer experience on male and female participants' valuing

of science will provide knowledge of the effect of such an experience on females.

As previously discussed, academically talented females have lacked the essential experiences needed to develop positive attitudes towards science. Their limited exposure to critical components of science such as laboratory equipment and positive role models has been related to their negative beliefs about their capabilities in the sciences (Kahle & Matyas, 1987). Additionally, minimal exposure to the various career options in science through a traditional school curriculum has kept females from viewing science as a viable career option (Malcolm, 1988). Academically talented females interested in the sciences have often felt that they were in a minority in schools, first as bright females and then as girls interested in a non-traditional area (Kerr, 1983). According to Silverman (1986), gifted females prefer to blend into their peer group whether it is in the regular or advanced class. Being different is very uncomfortable, but very common, for gifted females. Experiencing a science-peer group in the traditional high school is a rare occasion for many bright, talented girls in science. For academically talented females, immersion in an intensive, summer science experience with others of similar abilities and interests

could have a significant impact on their science-related attitudes, beliefs and career interests.

To measure the impact of such an experience on females' valuing of science, a repeated measures design was used. This design has the advantage of comparing the performances by the same group of subjects before and after exposure to a treatment. Three areas have been identified in the literature as affecting students' choices of career interests. They are positive attitudes towards science, an internal locus of control in science, and a commitment to science. These variables are discussed next.

Science-Related Attitudes

For many years science educators have included the development of the scientific attitude among the general aims of science education (Klopfer, 1980). Attitude is most often characterized by a list of component attributes such as objectivity, open-mindedness, skepticism and willingness to suspend judgement without enough evidence. Researchers have claimed that knowledge about scientific facts is of no use if there is no inclination to use facts. Scientific attitude represents the motivation that changes knowledge and skill into action and refers to a willingness to use scientific thinking and processes (Gauld, 1985).

The goals of science education historically have stressed the importance of developing scientific attitudes in students (Klopfer, 1980). In an analysis of 1,547 aims in the science education literature, Fraser (1977) found that almost half could be categorized as aims related to the development of the scientific attitude. However, there was little evidence that emphasis was placed on positive science attitudes in the classroom (Gauld, 1985).

How student attitudes toward science are formed and manifested is an important area of study for researchers in education (Simpson, 1978). Relationships between environmental influences and attitude formation in adolescents are of special concern. Three categories of variables -- self-concept, home environment and school environment, have appeared to play a critical role in the formation of student attitudes. A study by Talton and Simpson (1986), investigated the relationship of self, home and classroom environment with attitude toward science in adolescents. Of the three sets of variables, the classroom environment variable predicted the greatest amount of variance in attitude.

A study was conducted by Simpson and Oliver (1985) that focused on attitudes toward science of male and female science students in grades 6 through 10. The most

significant findings of the study were that attitudes toward science of adolescent students steadily declined from grade 6 to 8 with the sharpest decline from grade 7 to 8. At every grade level males exhibited significantly more positive attitudes toward science than females.

The study of the trait 'attitude toward science' was motivated by the apparent decline in the number of students enrolling in science courses and subsequently, not choosing careers in science. Students' perceptions of science have been measured appropriately by a variety of instruments. One instrument designed to measure the trait of 'attitude toward science' was developed by Fraser (1977; 1978). The Test of Science-Related Attitudes (TOSRA) (Fraser, 1977), has a sound theoretical basis and an impressive validation (Haladyna & Shaunessy, 1982). Fraser's instrument has been chosen over others, such as the Attitudes Toward Science (Simpson, 1978), because Fraser's theoretical framework was based on the aims of science education as proposed by Klopfer, (1971). Klopfer (1971) provided a clear comprehensive classification system for science education aims in which six conceptually different categories of attitudinal aims are distinguished. These six categories involve distinctions between attitudes to science and scientists, attitude to inquiry, adoption of scientific

attitudes like curiosity and open-mindedness, enjoyment of science learning experiences and interest in a career in science.

Another newly formed instrument used only in research thus far is the Science Attitude Survey (Matyas, 1985). This instrument was designed as part of a study that investigated the attrition among male and female college biology majors. Subscale factors include parental encouragement to succeed in science, confidence in and enjoyment of science, peer's feelings about science, attitudes towards women in science, peers of the opposite sex-competition with subject, feelings about success in science and teacher's confidence in students' abilities. This attitudes measure was also chosen for use in the study because of the face validity for use in study of bright adolescent females. The instrument appears to reflect the factors discussed in the literature regarding females' disinclination to enter science careers.

Science Locus of Control

Internal-external locus of control refers to the extent to which people perceive contingency relationships between actions and outcomes (Macdonald, 1973). Internal orientation refers to a belief in an individual's control

of destiny while external orientation is the personal belief that an individual's life is controlled largely by external factors, e.g., powerful others, luck or fate. The framework for locus of control is derived from the work of Rotter (1954) and Phares (1976). In conjunction with other relevant variables of academic performance, locus of control has received considerable attention (Crandall, Katkovsky, & Preston, 1965; Norwicki & Roundtree, 1971).

The perceived ability to control or not to control events is a motivational variable that is thought to affect students' achievement. In the literature, three theoretical perspectives exist that describe and provide evidence concerning the relationship of direction of control to achievement factors (Stipek & Weisz, 1981). The three perspectives include social learning theory (Rotter, 1966), attribution theory (Weiner, 1980), and intrinsic motivation (Harter, 1978; Deci, 1975). Within each model the construct "control" has a different meaning.

Rotter's social learning "control" focuses on the person's belief in contingency, that is, that academic outcomes are contingent on the person's behavior. The subject may or may not be in control of academic outcome.

In Weiner's attribution model there are both contingency and control dimensions of causal perceptions.

Measures for each dimension were developed as part of the model. The contingency dimension was labeled 'locus of causality' by Weiner (1980). Weiner's control dimension involves the subject's perception of his or her ability to change the factor that causes the outcome.

A third perspective of control theory was advanced by Harter (1978) who claimed that people are intrinsically motivated to interact effectively with their environment. She stated that perceptions of personal control are critical for a sense of competence.

Important educational implications for all three perspectives are that success or failure might be less important than a student's perceptions of the causes of the success or failure. Success strengthens self-perceptions of competence only if students perceive that they are responsible for the occurrence of success. According to Stipek and Weisz (1981), the effect of the success or failure on the student's achievement depends on the student's perceptions of the cause of that success or failure. Performance has been optimized when students accept responsibility for their successes, and understand that effort and persistence can overcome failures. Females might need to be taught these relationships more explicitly

since they tend to have lower self-esteem and consequently attribute success to external events (Stipek & Weisz, 1981.

For this study, an examination of the models and measurement tools available resulted in the choice of an instrument that specifically addresses a subject-specific approach to locus of control (Haury, 1984). Rotter (1975) stated that the specific area application of control has a stronger predictability of outcomes. Lefcourt (1976) predicted that the locus of control construct will demonstrate its greatest utility when investigators design instruments for testing specific hypotheses in specific subject areas. Tailoring a locus of control instrument to the particular context of interest results in heightened sensitivity to specific differences in control orientation among subjects. Therefore, in this study, Haury's (1984) Locus of Control in Science (LOCIS) measure was used to examine source of control in male and female adolescents before and after an intensive science experience.

Commitment to a Career in Science

Commitment to science was defined by Simpson and Troost (1982) as including interests, attitudes, values and other affective behaviors of students. Commitment to science is not defined only as the student's desire to

major in science, but also as the desire to take more science courses, to continue reading about science, to explore new scientific topics, and to be involved in science-related social issues. This definition suggests life-long learning patterns associated with science.

Certain variables have been determined to be related to commitment and career motivation. Based on a social learning theory perspective, Farmer's (1987) multivariate model for explaining gender differences in career and achievement motivation incorporated many related variables concerning the issue of females continuing on in science careers. Her conceptual model included personal, background, and environmental factors for testing three dimensions of motivation: aspiration, mastery and career. Background, personal, and environmental factors were found to influence motivation significantly. Farmer reported that interventions that stress role models, skill training, decision making, discussion and information influenced the motivation in achievement and career development.

Using a predictor set of variables, Sparrow (1987) investigated 489 females including 62 science majors and 427 nonscience majors, in the High School and Beyond 1980 Senior cohort. Using an ex post facto research design and 88 hypotheses, the researcher identified a profile of the

females committed to a career path in science. Multiple linear regression was employed to identify predictor variables. Sparrow found that female science college majors who perceived math as being useful in the future, obtained A's and B's in math, and had taken a particular number of science courses in high school. Subjects also identified science as a college major while a high school senior or as a college sophomore. They also had a tendency to be of Asian ancestry.

Baker (1987) found two additional factors that could be influential in females' career choice in science. The factors were role-specific self-concept in science and self-perception in terms of stereotypical masculine and feminine characteristics. Females preferring science-related careers and females preferring nontraditional careers, such as police and the military were found to have a positive role-specific self-concept and a masculine perception of themselves. Females preferring traditional careers such as teacher or hairdresser had a poor role-specific self-concept and a more feminine perception of themselves. Males as a group were found to have a more positive role-specific self-concept than females.

In summary, factors related to career commitment include familiarity with science through first hand

experiences, high achievement and a positive self-concept in the sciences. These factors may influence a students' motivation to continue on in the field of science. Effective interventions for academically talented females are needed to enhance the factors associated with motivation in science. This study will investigate the effect of such an intervention. The influence of the science experience in this study on science career commitment will be assessed with a questionnaire entitled the Science Impact Questionnaire. The instrument includes items regarding laboratory experiences, role models, encouragement and other potentially motivating experiences related to career development in science.

Summary

Following a review of the literature, the investigator was able to conclude that there is support for the theory that major gender differences occur in the development of motivation in science. Academically talented females have experienced many barriers to developing and maintaining an interest in and commitment to science. Females' experiences in science education have been less motivating than what males have experienced. Females tend to be less positive in science-related attitudes, lower in feelings of

control, and less motivated to continue on in a science major in college and in a long term science career. Science interventions are needed that address these differential needs by gender.

An intensive eight week summer science experience that includes key science experiences at a critical career exploration period in academically talented students' development may be one way to encourage academically talented females to maintain an interest in science. There is evidence that interventions can effect students positively. An intervention exists at the University of Florida that includes the important components needed for future scientists of both sexes. To date a study has not been conducted regarding the influence of the experience on students' motivation to continue in science. This investigation will be a study of the effects of the intensive summer science experience on science attitudes, locus of control in science and commitment to science in academically talented students. A difference in the outcomes between males and females will be investigated. The methodology for the study is discussed next.

CHAPTER III
METHODOLOGY

In this study the effect of an intensive science experience on the science attitudes, science locus of control and commitment to a science career of academically talented adolescents was investigated. In addition, the role of gender in the response to the treatment was explored. Also investigated was the differences between males and for females of prior science-related experiences. The research design was an quasi-experimental pretest-posttest treatment design. In this chapter the participants, research design, independent and dependent variables, description of study one, research hypotheses, and experimental procedures are presented.

Description of the Participants

The participants were 98 students from throughout Florida who had recently completed the 10th or 11th grade. Included in the sample were 47 females and 51 males. All participants were in the Student Summer Training Program (SSTP). They were selected due to their high interest and demonstrated ability in science-related areas as well as

recommendations from the high school staff. The students in this program are considered academically talented with test scores and grades well above the norm for their age group. The mean PSAT-Verbal score for the participants was 506 and the mean PSAT-Math score was 611.

The program personnel placed special emphasis on recruiting students from a variety of socio-economic levels, racial groups, and geographic regions throughout Florida. All five Florida Department of Education regions were represented. Four racial groups were also represented in the sample. They included 3% Hispanic, 7% Black, 23% Asian and 63% White students. Eleven of the students had recently completed 10th grade comprising 11% of the participants. The majority, or 89% of the participants, had recently completed 11th grade.

The family backgrounds of the students were diverse in respect to income, occupational levels, and size. Family yearly income was reported from $6,000 to $108,000, with the most frequent interval of family income reported to be in the $15,000 to $30,000 range. Ninety percent of the students received financial aid to attend the program. Parents' occupations of the selected participants were reported as professional, management, blue collar or laborer.

A total of 112 participants were enrolled in the summer program of 1989. Fourteen students were omitted from the final sample because they were either from out of state or their parents did not give permission for them to participate in the study.

Experimental Research Design

The research was designed as a pretest-posttest treatment study (Isaac & Michael, 1987). The treatment was participation in the intensive science experience. Pretest-posttest measures were obtained of the three dependent variables: (a) science-related attitudes, (b) science locus of control, and (c) commitment to a science career. Four instruments were used to measure the dependent variables. They were the Test of Science-Related Attitudes (TOSRA), Science Attitude Survey (SAS), Locus of Control in Science (LOCIS), and the Science Impact Questionnaire (SIQ). Pretest measures were obtained the first day of the experience and the posttest measures were gathered the last day of the experience. Other factors thought to potentially alter the impact of the treatment were also treated as independent factors. These factors were gender and prior science-related experiences.

Variables

Independent Variables

Three independent variables were used in the study: the treatment (intensive science experience), gender and prior science-related experiences.

Gender. A major focus of the study was the differential influence of the dependent variables on males and females. Thus, gender served as an independent variable.

Intensive science experience. The intensive science experience was an 8 week residential summer program that consisted of two major parts. Each part which provided key science experiences in training future scientists were: (a) participation in laboratory and academic research, and (b) career orientation to science and engineering fields. In the research component students worked 25 hours per week in a laboratory setting on a research project with a professor who functioned as a preceptor to the student. A student was matched with a professor based on the student's designated preference area of interest in science. The research projects served as the basis for research papers and oral presentations given by students during the summer program.

As part of the second component, career orientation to science and engineering fields, students attended various scientific activities and events. These included six hours of weekly lecture/demonstration/discussion sessions; four 60-minute classes per week in statistics or computer programming; four to five educational field trips within Florida; one to two 90-minute weekly seminars, workshops and special activities on technological topics and issues; four to five "special days" during the program to visit university facilities and faculty at the various science-related colleges, departments and centers; two 45 minute weekly general sessions for information and instruction and two weekly study group sessions based on research interests.

The lecture series was designed to expose the students to many areas and issues in the sciences while the excursions provided for field experience as well as peer interaction. The seminars and workshops allowed for more indepth and hands-on experiences which were not always available during the lectures or classes. "Special days" featuring on-site visitation to various science centers on campus offered students insights into possible science careers. The weekly peer study groups provided structured opportunities for students to share their research

experiences and become acquainted with the work of others. Students were then able to develop relationships with peers who shared similar science interests. Students received group and individual guidance related to their research projects as well as program and personal related topics. Group interaction also occured as students regularly engaged in scheduled and unscheduled social and recreational activities, arts programs, counseling and academic advisement as well as student career information sessions. A complete program description is located in Appendix A.

The researcher functioned as a consultant to the program director regarding the nature and needs of academically talented students and the issues related to differential prior science experiences of males and females. During the development and delivery of the program, the researcher met regularly with the director to help develop strategies in program planning, met with program counselors to discuss the pertinent issues of science, gender and academic talent, and spoke at general sessions for participants on advanced ability and individual differences.

Prior science-related experiences. Six questions were developed to ascertain prior science-related experiences.

Prior experiences were those described in the literature as different for males and females. They were a primary delineator for students who were interested in or not interested in science as a career option. Two key factors were chosen because of their prominence in the literature; hands-on experiences and encouragement.

Five questions were designed by the researcher to reflect different types of prior science-related hands-on experiences (See Appendix B for questionnaire). Information was obtained about favorite and frequently played with toys when a young child, science activities experienced in school, having made something that worked and frequency of involvement in science fairs. Forced options were listed for toys such as blocks and electronic games, as well as for school science experiences, such as making a robot and dissecting animals. Making something that worked was answered yes or no, followed by an open-ended description of what had been made. All experiences were added together to form a total score of all prior hands-on experiences.

One question was used to assess encouragement experiences. The question asked, "Is there someone who encouraged your interest in science? Yes or No? If yes, describe the person's characteristics and their

relationship to you". A tally of the descriptions given by subjects resulted in seven options: teacher, father, mother, sibling, other family members, scientists/adult friends/mentors, and peer friends. A total score for this question was formed that reflected these eight possibilities, the yes/no and the seven options.

A Pearson correlation analysis was used to determine whether hands-on experiences and encouragement experiences were correlated. They were not significantly correlated and so remained two separate factors of prior science-related experiences.

Dependent Variables

There were three dependent variables, science-related attitudes, locus of control in science, and commitment to a science career. Four instruments were used for the three dependent variables. All the instruments required written responses.

Science-related attitudes. Two instruments were used to measure science-related attitudes. The Test of Science-Related Attitudes (Fraser, 1981) was used as a repeated measure before and after the intervention. The Science Attitude Survey (Matyas, 1985) was used as a posttest only measure after the intervention.

Test of Science-Related Attitudes. The Test of Science-Related Attitudes (TOSRA; Fraser, 1981) includes seven attitude scales, each having 10 statements requiring a Likert-type response selected from strongly agree, agree, neutral, disagree and strongly disagree. The scales are designated as:

1) Social implications of science,
2) Normality of scientists,
3) Attitude of science inquiry,
4) Adoption of scientific attitudes,
5) Enjoyment of science lessons,
6) Leisure interest in science, and
7) Career interest in science.

The scales are designed to encompass the broad concept of science attitude. Scales 1, 2 ,6, and 7 represent the aspect of science that their title suggests. Scales 3 and 5 reflect the extent to which students like or dislike of classroom science. Scale 4 focuses on the attributes expected of scientists. This instrument was developed for secondary students, both in junior and senior high school. There is no time limit. It is suggested in the manual that high school students should require 25 to 30 minutes to complete the test.

The TORSA has been used in a number of public and private schools in Australia and in two American Catholic schools. The data from the American schools were similar to the Australian data. These findings suggest that the scales may have validity. According to Shrigley (1983), more American data on reliability and validity should be collected by researchers using the instrument.

The author considers the TOSRA to be seven different scales. Therefore, the data have been divided into seven parts. Each scale appears distinct with intercorrelations among the scales cited by the author as ranging from .10 to .59 with a mean of .33, suggesting that each scale is rather autonomous, measuring a different component of science attitude. Test-retest reliability coefficients on the seven scales range from .69 to .84. Using the Cronbach reliability alpha coefficient, the author tested the internal consistency of the scales, gathering data for the grades 7 - 10. Alphas on the seven scales in the four grade levels ranged from .66 to .93.

Scale 4 had the lowest alphas for each grade level, .66, .64, .69 and .67, suggesting that it would be valuable for researchers to continue gathering reliability data. Crano and Brewer (1973) suggested a minimum reliability coefficient alpha of .80 for a Likert attitude scale. No

reliability and validity data is available for eleventh grade students.

The TOSRA was chosen because of the construct and face validity. The test is designed to measure indicators of science interests that have been identified in the literature (Klopfer, 1971; Shrigley, 1983). Another test, the Attitudes Towards Science Scale (Simpson, 1982), which has been used in numerous studies in the United States was not chosen because it was more closely tied to earlier than 10th grade classroom experiences of average students not as sophisticated in science as the academically talented students in this study.

Science Attitude Survey. Matyas (1985) developed the Science Attitude Survey as part of a study to predict attrition among male and female college biology majors. The instrument was developed with seven subscales. They included Parental Encouragement to Succeed in Science (PARENT), Confidence In/Enjoyment of Science (ABIL), Peer's Feelings About Science (PEERS), Attitudes Toward Women in Science (MFABIL), Peers of the Opposite Sex-Competition with Subject (PEEROP), Feelings about Success in Science (SUCC), and Teachers' Confidence in Students' Abilities (TCHR).

Subscale factors were analyzed by using an oblique rotation. Parental Encouragement had an alpha reliability of .87, and Confidence in Science had a alpha reliability of .82. The other subscales had reliabilities of .73 for Peer's Feelings About Science, .74 for Attitudes Toward Women in Science, .81 for Peers of the Opposite Sex: Competition With Subject, .77 for Feelings About Success in Science and .78 for Teacher's Confidence in Students' Abilities.

Factor loading analysis was conducted for each of the 40 items. Three questions were omitted, 13, 21, and 30 due to low loadings on several factors.

Subscale (factor) correlations were conducted. Only one pair of subscales had a factor correlation equal to or greater than .35; PARENT and SUCCESS factors had a correlation of -.35.

The Science Attitude Survey is comprised of 40 items designed to permit subjects to use a Likert scale response format to indicate the degree to which they agree or disagree with the ideas expressed. Items are written as positive and negative. To score the instrument, positive statements are scored at the higher end of the scale, 4 or 5, while the negative statements are reversed in value. Since subscales are considered independent factors, there

is no combined total score for this instrument. Each subject receives seven separate scores.

Science locus of control. The 18-item Locus of Control in Science (LOCIS) instrument developed by Haury (1984) measures beliefs people hold regarding their personal efficacy, or ability to influence the outcome of events in situations where decisions or actions require either the application of scientific knowledge or the use of reasoning skills associated with scientific thinking. The LOCIS is an area-specific instrument for assessing locus of control orientations in situations involving scientific concepts as a way of thinking.

The instrument was designed to assess the basis on which elementary teachers express negative attitudes towards science. Consequently, the population sampled in the development of the instrument were students seeking certification as elementary school teachers; undergraduate liberal arts students, and experienced teachers. The author has given permission for the instrument to be adjusted for use with a different population in the present research study (Haury, personal conversation and correspondence, May, 1989).

The LOCIS has two forms. LOCIS I uses a dyadic, forced-choice format based on Rotter's (1966) I-E Scale and

dichotomized response items with regard to controlling agents, similar to Lefcourt's (1981) application of attribution theory (Weiner, 1980 and others). The LOCIS I form was developed to minimize test-retest bias but was found to be inconsistent (Haury, 1985).

The LOCIS II was developed as an alternate form using a five-point, Likert-type scale format. The LOCIS II Scale is scored by summing the scores for individual items. Possible scores range from 1 for a strongly external response to 5 for a strongly internal response. An overall score represents an estimate of science locus of control internality, that is, the belief that personal efficacy or ability to influence the outcome of events in science originates from an internal orientation.

Both versions of the LOCIS sampled the domains of control orientation. Equal numbers of items were developed for internal and external orientation, instances of success and failure, and situations in the perspective of first person and third person. The first and third person perspective represented personal control versus control by people, reflecting personal ability and personal effort.

As demonstrated by the preliminary work on the LOCIS (Haury, 1984), it seemed evident that science locus of control orientation could be measured most reliably with

the LOCIS II Scale since it exhibited an alpha of .72 or greater for all the groups studied. A comparison of the coefficient derived among the preservice teachers from concurrent administration of the two forms, LOCIS I and LOCIS II, (alpha .63) when the two scales were administered separately before and after an 11 week treatment (alpha - .51), indicated moderate stability of the control orientation estimates. The second correlation was slightly weaker due to its being a posttest measure for half the subjects after an intervention to promote internality of control. The correlation coefficient would be expected to decrease somewhat if the treatment was effective. As reported (Haury, 1984; 1985), the treatment did seem to promote internality. The LOCIS II Scale was sensitive enough to allow detection of a modest difference in control orientation between the two treatment groups on pretest and posttest measures. Additionally, experts who responded to the LOCIS Scales found a maximum functional reliability of essentially 1.00 that placed no evident constraints on content validity.

Moderately strong correlations were demonstrated between item responses and total scores, (alphas .70 to .73). While both scales have internal consistency reliability estimates from .73 to .75, LOCIS II

demonstrated greater consistency in subsequent administrations. The reliability of LOCIS II ranged from a low of .72 to a high of .75. The LOCIS II instrument, with higher consistency levels from .72 to .75 was used in the present study for both the pretest and posttest.

Although establishing validity is a gradual process, there is initial evidence for content validity, criterion-oriented validity and construct validity on the LOCIS II. Content validity was confirmed by informed evaluators. Evidence of criterion-oriented validity was found through the correlation of LOCIS Scale scores with expressed science attitudes and the Rotter, a measure of generalized locus of control orientation. A network of predicted relationships supported construct validity. There was failure, though, to detect the expected relationship between LOCIS Scale score and academic exposure to science. The relationship appeared to exist but was not detected using the particular sample of subjects who did not represent the full range of academic experiences in science (Haudry, 1984).

Other instruments have been developed that measure general control orientation. Since the original Rotter I-E Scale (Rotter, 1966), there have been refinements in assessing control theory through the use of

multidimensional scales (Reid & Ware, 1974) and greater specification of controlling agents in scale items (Levenson, 1973). No other instrument besides the LOCIS II has been developed to measure the control variables specific to science. Lefcourt (1976) predicted that the locus of control construct would demonstrate the most power when developed for area-specific purposes. Consequently, the LOCIS II, as a science-specific tool, was determined to be an appropriate tool for use in the present study.

Commitment to career interest in science. A questionnaire, The Science Impact Questionnaire, was developed by the researcher to assess the career-related experiences and perceptions of participants in the sample prior to the intervention and after the intervention. The instrument was developed based on the concepts proposed by Mason and Kahle (1989) and Casserly (1979). They identified the key experiences of peer interaction, hands-on science experiences, scientific research, career knowledge and role models as critical factors in the development of science-related career interests of females. The instrument primarily uses a Yes/No and 5-part Likert format. Students respond either to statements with an indication of agreement - strongly agree, agree, neutral,

disagree or strongly disagree, or to statements indicating frequency - frequently, often, sometimes, rarely and never. A total score is obtained by tallying the numerical value for each response.

Study One--Pilot Study

In order to determine the gender sensitivity of the instruments, they were first administered to a comparable, academically talented high school sample of students. After permission was obtained from the Alachua County School Board to conduct the pilot study, students in Advanced Placement (AP) chemistry and biology classes in two high schools were administered the instruments during class time. Prior to the testing, parents and guardians of the students gave permission by returning a letter of consent developed by the researcher (See Appendix C). A total of 66 students, 26 females and 40 males comprised the initial study sample.

The data from the initial study were analyzed by gender to determine variance on each of the five instruments. The instruments included the Test of Science-Related Attitudes (TOSRA), Locus of Control in Science (LOCIS), Science Impact Questionnaire (SIQ) and six

questions reflecting prior hands-on and encouragement experiences.

For the hands-on experience factor, a t-test procedure was used to compare mean scores between male and female groups. While mean scores were different (males 13, females 11.56), this difference was not a significant difference ($t = -1.36$, $p = .172$). A frequency tally of individual items yielded percentage differences between groups on most items. Therefore, it appeared that these items did show some variance by gender.

For the encouragement experience factor, a t-test was again used to analyze mean scores between male and female groups. A significant difference was again not found for gender group means ($t = -.553$, $p = .579$).

Gender differences on the Test of Science-Related Attitudes (TOSRA) were examined using a multivariate analysis of variance for overall gender effect for all the subscales together. A Pearson Correlation of subscales yielded a significant correlation for many subscales among males and among females thus supporting the use of a MANOVA for overall gender effect. The results were statistically significant at the .05 confidence level ($F = 2.38$, $p = .0327$). When individual subscales were analyzed for gender differences using a t-test procedure, only one

subscale resulted in a significant gender difference, "Social Implications of Science" ($t = -2.25$, $p = .024$).

The Locus of Control in Science (LOCIS) was analyzed using a t-test procedure. A statistically significant gender difference was not found ($t = -.073$, $p = .941$) for total mean scores.

A t-test was employed to analyze the significance of gender differences between group means on the Science Impact Questionnaire (SIQ). A statistically significant difference resulted ($t = -2.77$, $p = .0055$).

A MANOVA procedure was also employed to determine overall gender differences on the seven subscales of the Science Attitude Survey (SAS). A statistically significant difference was found for overall sex effect ($F = 3.19$, $p = .0064$). A t-test procedure to determine gender differences on individual subscales was then employed. Three subscales did yield significant gender differences at the .05 level. Confidence In/Enjoyment of Science yielded mean scores for males at 32.55 and females 30 ($t = -2.03$, $p = .0420$). Peers' Feelings About Science had mean scores of males 16.85 and females 15.65 ($t = -1.988$, $p = .0467$). The third significant subscale was Attitude Toward Women in Science with mean scores of 24.45 for males and 26.30 for females ($t = 2.03$, $p = .0422$).

In summary, gender differences were found on all, or parts of all measures except the Locus of Control in Science instrument. Therefore, all except the latter appear to be gender sensitive with this particular population of academically talented high school students interested in science. MANOVA procedures also appeared appropriate for the TOSRA and SAS with their highly correlated subscales.

Research Hypotheses

The following research hypotheses were tested:

Gender Differences Before Treatment

Ho1: There are no significant differences between academically talented male and female high school students on science-related attitudes as measured by the Test of Science-Related Attitudes (TOSRA) prior to an intensive science experience.

Ho2: There are no significant differences between academically talented male and female high school students on science locus of control as measured by the Locus of Control in Science (LOCIS) prior to an intensive science experience.

Ho3: There are no significant differences between academically talented male and female high school students

on level of commitment to a science career as measured by the Science Impact Questionnaire (SIQ) prior to an intensive science experience.

Ho4: There are no significant differences between academically talented male and female high school students on prior science-related hands-on experiences.

Ho5: There are no significant differences between academically talented male and female high school students on the prior science-related experiences of encouragement.

Treatment and Gender Effects

Ho6: There are no significant effects of gender and treatment (an intensive science experience) on the science-related attitudes of academically talented high school students.

Ho7: There are no significant effects of gender and treatment (intensive science experience) on the locus of control in science of academically talented high school students.

Ho8: There are no significant effects of gender and treatment (an intensive science experience) on the level of commitment to a science career of academically talented high school students.

Gender Differences After the Treatment

Ho9: After an intensive science experience, there are no significant differences between male and female academically talented high school students in science attitudes as measured by the Science Attitude Survey.

Experimental Procedures

All participants were administered the Test of Science-Related Attitudes, the Locus of Control in Science, and the Science Impact Questionnaire together during one large class group session as they began the intensive science experience. In the same session they completed the questionnaire concerning six previous science experiences. The students completed all the instruments in one session. They repeated the same instruments again during the general session scheduled the last week of the intensive science experience, but instead of the six questions, they were administered the Science Attitudes Survey. The tests were administered by the researcher in all sessions. The tests were coded for anonymity. Tests were hand scored by the researcher.

The research and findings are reported in Chapter IV. In Chapter V there is a discussion of the findings and the implications for related research.

CHAPTER IV
RESULTS

The purpose of this study was twofold, first to determine if academically talented adolescents' perceptions and aspirations related to science study and careers were affected by an intensive field-based laboratory science experience. Secondarily, the purpose was to determine if the effect varied by gender. A secondary focus was whether male and female participants varied in amount of prior hands-on experience with science and encouragement to study science. The three outcome variables of interest were (a) science-related attitudes, (b) science locus of control, and (c) commitment to a science career.

Four instruments were used to assess the dependent variables in this study, The Test of Science-Related Attitudes (TOSRA), Locus of Control in Science (LOCIS), Science Impact Questionnaire (SIQ), and Science Attitudes Survey (SAS). As reported in Chapter III, all instruments were administered to a local group of 66 high achieving science students (40 males and 26 females) in a preliminary study. This first study was conducted to determine gender sensitivity of the instruments with this particular

population of academically talented high school students before selecting the data analysis procedures for the study of the intensive science experience.

This chapter has been organized into the following sections: first, the descriptive statistics of the sample in study two are described followed by the results of the multivariate and univariate analyses of variance used to test the hypotheses. Finally, a summary of the overall results of the study are presented.

Descriptive Statistics of the Sample

The sample in this study was a group of male and female adolescents who participated in an intensive science experience at the University of Florida. The total enrollment of the 1989 program was 112 students. Parental consent forms were mailed to all participants and returned by parents through the mail to the researcher. After eight out-of-state students were automatically omitted and four more taken out whose parents did not grant permission for participation in the study, the final sample consisted of 98 students, 47 females and 51 males. For the subjects who had taken the PSAT the mean PSAT Verbal score for the group was 506, while the mean PSAT Math score was 611. Sample

intelligence test scores and SAT scores when available are presented in Table 1.

The five Florida Department of Education geographic regions were represented in the sample. Thirteen percent of the group was from the northwest-Panhandle area, 21% from the north central area, 26% from the mideast area, 8% from the west coast and 19% from south Florida. The percentage of racial groups represented included 3% Hispanic, 7% Black, 23% Asian and 63% White students. Eleven of the students comprising 11% of the participants, had recently completed 10th grade. The majority, or 89% of the participants, had recently completed 11th grade. In Table 2 racial representation by gender is described.

The family backgrounds of the students were diverse in both size and income levels. Out of the 87 (89%) participants who reported data, 82% of the participants said they lived with both their parents while 18% lived with only one parent. Eight percent of the male participants lived in one parent homes while 32% of the females lived in one parent homes. Students came from both large and small families that ranged in size from two to eleven members. Seventy percent of the sample reported family size data. The most common size family reported by 48% of the participants was four members. Six students

Table 1
Individual Test Scores for Participants

Intelligence Test Scores

Gender	N	Percentage of Sample	Range	Mean
Males	25	49%	118-160	139
Females	24	51%	112-142	136
Total	49	50%	112-160	136

Preliminary Scholastic Achievement Test Scores

Gender	N (Total=98)	Percentage of Sample Reported	PSAT-V mean	PSAT-M mean
Males	49	96%	502	620
Females	34	72%	512	599
Total	83	85%	506	611

Note - Tallied for all participants for whom scores were available.

were from two-member families and six students came from families ranging from seven to eleven members. Students reported that family yearly income ranged from $6,000 to $108,000, with the most frequent interval of income reported by 31% of the participants to be in the $15,000 to

Table 2
Racial Group Representation by Gender

Gender	N	White	Asian	Black	Hispanic
Males	51	60%	27%	10%	2%
Females	44	66%	19%	4%	4%
Total	95	63%	23%	7%	3%

Note - Tallied for all participants for whom data was available.

$30,000 range. Ninety percent of the students received financial aid to attend the program.

Fathers' occupation included the professional areas of law, engineering, and medicine, various levels of management, blue collar jobs of metal cutter and electrician, laborer positions of shrimper, net repairman, and custodian. Mothers also worked in a variety of areas but tended to cluster in the traditional fields of education, nursing, and secretarial work. Approximately 25% of the students reported that their mothers' occupation was that of homemaker.

In summary, although students were somewhat homogeneous in academic talent they reported diverse backgrounds. Represented in the sample were four racial

groups, five geographic regions within Florida and a diversity of family backgrounds.

Hypotheses Testing

Gender Differences Prior to Treatment

Ho1: There are no significant gender differences between academically talented male and female high school students on science-related attitudes prior to an intensive science experience (as measured by the Test of Science-Related Attitudes (TOSRA).

Since the TOSRA has seven subscales, a multiple variate analysis (MANOVA) was completed on the TOSRA pretest scores. Fraser (1979) described the subscales of the TOSRA as independent factors based on the heterogeneous population he used in developing the instrument; however, in this more homogeneous population of academically talented students interested in science, a majority of the subscales correlated at a .05 level of significance making the MANOVA procedure appropriate. It was determined that the overall gender effect for all the subscales together was significant at the .05 level ($F = 2.737$, $p = .013$).

Subscales were then analyzed individually for gender differences using an univariate t-test procedure. As indicated in Table 3, insignificant gender differences were found for all subscales.

In summary, there was an overall significant difference by gender in science-related attitudes measured on the TOSRA before the intervention. However, the univariate analyses of gender differences in individual scores found no significant differences on the individual scales. Evidently there is a global concept of science attitudes that did vary by gender. The null hypothesis that there were no gender differences in science attitudes before the intervention was rejected.

Ho2: There are no significant differences between academically talented male and female high school students on locus of control in science prior to an intensive science experience (as measured by the LOCIS).

Locus of control in science was measured by the instrument Locis of Control in Science that yields a total score reflecting the degree of internal control in ability and effort. Gender group mean scores before the intensive science experience were analyzed using a t-test procedure. As shown in Table 4, mean scores for males and females were almost identical in that there was no significant difference ($t = -.018$, $p = .985$). The null hypothesis was not rejected.

Table 3
t-Test for Gender Differences on the TOSRA Scales Before the Science Experience

Subscales	Gender	M	SD	t	p
Social Implication of Science					
	Males	41.74	4.40	.094	.924
	Females	41.82	4.94		
Normality of Scientists					
	Males	36.96	4.42	.606	.545
	Females	37.53	4.86		
Attitude to Scientific Inquiry					
	Males	36.88	5.50	-.282	.778
	Females	36.55	5.89		
Adoption of Scientific Attitudes					
	Males	41.26	4.18	-.005	.995
	Females	41.25	3.92		
Enjoyment of Science Lessons					
	Males	41.48	6.42	-1.28	.202
	Females	39.91	5.52		
Leisure Interest in Science					
	Males	38.50	6.26	-1.08	.280
	Females	37.17	5.76		
Career Interest in Science					
	Males	39.48	6.40	-.620	.536
	Females	38.70	5.92		

Table 4
t-Test for Gender Differences on Pretest LOCIS

Gender	N	M	SD	t	p
Males	50	66.34	5.61		
				-.018	.985
Females	47	66.31	5.27		

Ho3: There are no significant differences between academically talented male and female high school students on level of commitment to a science career prior to an intensive science experience (as measured by the Science Impact Questionnaire).

Career commitment in science was measured by a questionnaire developed by the researcher entitled, Science Impact Questionnaire. The instrument yielded a total score reflecting positive statements related to career interest in science. A t-test procedure was used to compare group means. There was no significant difference in male and female mean level of career commitment ($t = -1.63$, $p = .090$). However, the male group mean (57.97) was higher than the female group measure (54.91). Results are listed in Table 5. A frequency of instrument items was run to determine frequencies and percentages by gender groups. Results of individual questions are listed in Table D-3.

Table 5
t-Test for Gender Differences on the Pretest SIQ

Gender	N	M	SD	t	p
Males	49	57.97	8.58		
				-1.63	.1059
Females	47	54.91	9.79		

Although there was not an overall significant gender difference, there were interesting differences among the questionnaire items. Eighty-four percent of males were planning a career in science before the intervention while 73% of the females were. The career area chosen first by 33% of the males was engineering and their second most frequent choice was medicine/health at 27%. Among the females, 73% chose medicine/health as their first choice while 19% reported engineering as their second choice. Both males (51%) and females (57%) were unsure of their career goals and the way in which they would achieve those goals (males-51%, females-55%).

Males and females also had differing experiences that influenced their interest in science. Males most frequently stated their fathers (18%) influenced them. Females stated that their love of science (19%), was an important

influence. Nineteen percent of the females also described personal experiences such as a family member's illness or seeing famine and sickness in a foreign country that was a participant's homeland and wanting to do something about it, as an influencer. In summary, although total scores reflected no significant difference between males and females, some individual items suggest different patterns between males and females.

Ho4: There are no significant differences between academically talented male and female high school students on prior science-related hands-on experiences

A t-test was conducted to examine differences in mean scores between males and females on prior hands-on science-related experiences. Hands-on experiences were measured by five questions. A total score yielded a frequency of experiences relating to favorite toys and frequency of play with science-related toys, school science activities, building something that worked and involvement in science fairs.

As shown in Table 6, the results of the t-test procedure indicated no significant difference among the males and females ($t = -1.68$, $p = .096$). Thus, the null

hypothesis was not rejected. There does appear to be a trend of males having more hands-on experience than females.

Table 6
t-Test for Gender Differences on Prior Science-Related Hands-On Experiences

Gender	N	M	SD	t	p
Males	50	14.58	4.39		
				-1.68	.096
Females	47	13.13	4.10		

Although on many science-related hands-on activities males had a higher frequency, females had higher frequencies than males on some of the items (See Appendix D, Table D-4). Females had a higher frequency on what were their "favorite toys" with three types of toys: dolls (2% males and 53% females), crafts (14% males and 53% females), and puzzles (54% males and 70% females). Dolls were not included in total scores since they are not considered a "hands-on" science-related toy, but were included in the frequency count to determine how many of the participants did actually play with dolls. In terms of frequency of

playing with science-related toys, problem-solving activities, and action games, females played more often than males with five of the toys. They were board games (males 24% and females 32%), sports (males 20% and females 26%), crafts (males 2% and females 19%), and puzzles (males 12% and females 38%).

Females also had a higher frequency of school-based science experiences. Females participated slightly more than males in science labs (males 54% and females 55%), making plants grow (males 22% and females 30%), doing experiments (males 72% and females 77%) and dissecting animals (males 50% and females 57%). Females participated more than males in science fairs in 5th grade (males 18% and females 57%) and by 10th and 11th grades equally with males (10th - 40%; 11th - 34%). Otherwise, males participated more often than females in the science fairs from 6th - 9th grades. Males, more often than females (males 62% and females 40%) had built something that worked. Males reported building items such as cars and machines.

In summary, no overall gender difference was found for amount of prior hands-on experiences. However, there were individual item differences between males and females on toys played with, science activities experienced in school,

building something that worked and science fair participation.

Ho5: There are no significant differences between academically talented male and female high school students on prior science-related experiences of encouragement.

A t-test was conducted to determine that there are no significant differences between males and females on the prior science-related experiences of "encouragement". Encouragement experiences were reflected in the question "Did someone encourage your interest in science? If so, who, and what was their relationship to you?" Students responded by answering yes or no and then describing who influenced them. As indicated in Table 7, there were no significant differences in encouragement between males and females ($t = .180$, $p = .856$). Thus, the null hypothesis was not rejected.

The individual roles of people who encouraged male and female students are found in Table 8. Females were more often encouraged than males by teachers (males 25% and females 35%) and mothers (males 10% and females 16%). Males on the other hand, were encouraged more often by fathers (males 23% and females 16%), scientists and adult friends (males 15% and females 6%), and peers (males 10% and females 0).

Table 7
t-Test for Gender Differences in Prior Science-Related Encouragement

Gender	N	M	SD	t	p
Males	50	2.125	2.049		
				.180	.856
Females	47	2.000	1.732		

Table 8
Prior Science-Related Encouragement Items

Types of People Who Encouraged	Males		Females	
	N	Percent	N	Percent
Reported encouragement	27	56	27	55
Teacher(s)	12	25	17	35
Father	11	23	8	16
Mother	5	10	8	16
Sibling	4	8	3	6
Other Family Member(s)	3	6	2	4
Scientists/Adult Friends	7	15	3	6
Peers	5	10	0	0

In summary, there was no overall significant gender difference for level of prior encouragement experiences. Males and females did differ on individual types of people who encouraged them. Males were more often encouraged by their fathers and adult friends, scientists or mentors. Females were more often encouraged by mothers and teachers.

Treatment and Gender Effects

A series of repeated measure analyses of variance were conducted to examine treatment and gender effects. In these analyses the pretest and posttest scores were considered a within subjects factor and gender was the independent factor.

Ho6: There are no significant effects of gender or treatment (an intensive science experience) on the science-related attitudes of academically talented high school students.

A repeated measures multiple analysis of variance was computed. The source table for this analysis is presented in Table 9. Inspection of the analysis reveals no interaction effect ($F = 1.42$, $p = .170$). There was also no main effect due to gender ($F = 0$, $p = .948$). There was a highly significant effect due to treatment ($F = 17.662$,

p = .0001). Subjects changed significantly in overall science-related attitudes as a result of the intensive experience. Thus, the null hypothesis of no effect was rejected.

Table 9
Source Table for the Repeated Measures Multiple Analysis of Variance of TOSRA Scales by Gender

Source of Variation	SS	df	ms	F	p
Gender					
S	.7626	1	.7626	.00	.9486
Error	17337.7720	95	182.5029		
Treatment					
S	4517.5412	13	347.5031	17.66	.0001
Error	20698.9947	1235	16.7603		
Gender X Treatment					
S	494.8211	13	38.0631	1.4163	.1694
Error	20698.9947	1235	16.7603		

Univariate analyses were then computed for each TOSRA subscale to determine if there were any significant changes after treatment on specific attitudes. There was significant change on most subscales. The means and

standard deviations of the score changes by gender are presented in Table 10. For males there were significant differences on the following subscales: Social Implications of Science ($t = 3.50$, $p = .0010$), Adoption of Scientific Attitudes ($t = 4.64$, $p = .0001$), Enjoyment of Science Lessons ($t = 3.09$, $p = .0033$), Leisure Interest in Science ($t = 2.70$, $p = .0095$), and Career Interest in Science ($t = 2.95$, $p = .0048$).

Among females significant differences were found on all the subscales: Social Implication of Science ($t = 2.80$, $p = .0073$), Normality of Scientists ($t = -2.81$, $p = .0072$), Attitude to Scientific Inquiry ($t = 2.52$, $p = .015$), Adoption of Scientific Attitudes ($t = 4.46$, $p = .0001$), Enjoyment of Science Lessons ($t = 2.42$, $p = .019$), Leisure Interest in Science ($t = 1.97$, $p = .037$), and Career Interest in Science ($t = 2.52$, $p = 015$).

The differences indicated a decrease in group mean scores after the experience. For females, there was a significant increase in the perception of scientists as normal people.

Table 10
Pretest-Posttest Score Changes on the TOSRA Scales

Subscales	Males				Females			
	Mean	S.D.	t	p	Mean	S.D.	t	p
Social Implication	2.5	5.04	3.50	.0010*	1.53	3.74	280	.0072*
Normality	.90	6.00	1.06	.294	-2.81	4.71	-2.81	.0072*
Scientific Inquiry	.64	5.45	.830	.410	1.38	3.75	2.52	.015*
Adoption Attitudes	3.06	4.84	4.46	.0001*	2.29	3.52	4.46	.0001*
Enjoyment Lessons	5.76	.201	3.09	.0033*	1.40	3.97	2.42	.019*
Leisure Interest	2.04	5.34	2.70	.0095*	1.14	3.98	1.97	.037*
Career Interest	2.34	5.60	2.95	.0048*	2.14	5.82	2.52	015*

* Significant at .05 level

Ho7: There are no significant effects of gender or treatment (intensive science experience) on the locus of control in science of academically talented high school students.

A general linear models procedure was used to conduct a repeated measures analysis of variance to test this hypothesis. The source table for this ANOVA is located in Table 11. There was no interaction effect of gender and treatment on the locus of control in science scores

Table 11
Source Table for the Repeated Measures Analysis of Variance of LOCIS Scores by Gender

Source of Variation	SS	df	ms	F	p
Gender					
S	28.632	1	28.633	.45	.504
Error	6048.047	95	63.664		
Treatment					
S	66.393	1	66.393	3.295	.0726
Error	1913.916	95	20.146		
Gender X Treatment					
S	30.207	1	30.207	1.50	.224
Error	1913.916	95	20.146		

($F = 1.50$, $p = .223$). There were also no significant differences due to gender ($F = .45$, $p = .504$) and the intensive science experience ($F = 3.23$, $p = .072$). The null hypothesis of no effects is thus not rejected.

Ho8: There are no significant effects of gender or treatment (an intensive science experience) on the level of commitment to a science career of academically talented high school students.

A repeated measures analysis of variance (ANOVA) was also computed to test this hypothesis. The source table

for this analysis is located in Table 12. There was no significant interaction of gender and treatment on the level of commitment to a career in science ($F = .272$, $p = .603$). There was also no main effect due to the treatment, participation in the intensive science experience ($F = .385$, $p - .536$) on the level of commitment. A significant difference was found between males and females ($F = 4.95$, $p = .0285$) on level of commitment with males scoring a mean of 58.92, and females 55.79. Clearly, the boys in this group of academically talented students arrived and remained more committed to a science career than did the females.

Gender Differences After Treatment

Ho9: After an intensive science experience, there are no significant differences between male and female academically talented high school students in science attitudes as measured by the Science Attitude Survey.

The Science Attitudes Survey has seven subscales. Initial analysis of the subscales indicated a high level of correlation among the subscales (See Table D-5). Thus the subscales scores were entered together in a multiple analysis of variance. There was a significant difference between males and females on the the composite score

Table 12
Source Table for the Repeated Measures Analysis of Variance of SIQ Scores by Gender

Source of Variation	SS	df	ms	F	p
Gender					
S	546.003	1	546.003	4.95	.0285
Error	10373.976	94	110.361		
Treatment					
S	17.883	1	17.883	.385	.536
Error	4360.862	94	46.392		
Gender X Treatment					
S	12.617	1	12.617	.272	.603
Error	4360.862	94	46.392		

($F = 6.85$, $p = .0001$). The source table for this analysis is located in Table 13.

Univariate t-tests were then computed for each subtest. Statistically significant gender differences were found for three of the subscales. Subscale means and standard deviations by gender are listed in Table 14.

Females were more positive in attitude about women in science, competition with the opposite sex, and feelings

Table 13
Source Table for Gender Differences in Science Attitude Survey Subscales

Source of Variation	df	F	p
MANOVA for SAS Subscales	7	6.853	.0001*

Univariate Analysis of Variance

Source of Variation	df	t	p
Parental Encouragement	96	1.153	.248
Confidence in Science	96	-.032	.974
Peers' Feelings About Science	96	-.376	.706
Attitude Toward Women	96	5.32	.0001*
Opposite Sex Competition	96	2.55	.0122*
Feelings About Success	96	2.88	.0040*
Teacher's Confidence	96	.051	.959

* Significant at the .05 level.

about success in science. Therefore, the null hypothesis of no differences in attitude was rejected.

Table 14
Mean Scores and Standard Deviations for Science Attitude Survey Subscale Gender Differences

Subscales	Males		Females	
	M	S D	M	S D
Parental Encouragement	34.17	7.02	35.98	6.13
Confidence in Science	30.58	6.46	31.46	4.09
Peer's Feeling about Science	17.43	2.76	17.38	2.86
Attitude Toward Women	21.37	3.68	25.34	2.96
Opposite Sex Competition	12.86	2.82	14.42	3.41
Feelings About Success	19.74	3.21	21.53	2.12
Teacher's Confidence	15.84	3.10	16.08	2.07

Summary

This study had three sets of hypotheses. The first set examined gender differences prior to the intensive science experience. The second set tested the effects of gender and the treatment on the dependent variables. The last hypothesis looked at differences in attitude after the experience.

Before the intensive science experience there were gender differences in science-related attitudes. The

global concept of science-related attitudes varied by gender among academically talented high school students. There were no gender differences in locus of control in science and level of prior science-related experiences though the sources of experiences did vary by gender even though the amounts did not vary significantly.

After the intensive science experience there were no differences between males and females in science-related attitudes as measured by the TOSRA. Attitudes changed significantly for all students. Whereas males had entered with a different and higher level of attitude than females, at the end both genders continued to demonstrate a significant difference. It appears that the treatment became an equalizer between males and females for this variable. Only females changed in a positive direction on one subscale - normality of scientists. There was no change for locus of control in science or for commitment to a science career, due to the intensive science experience for the group as a whole. While males and females were similar on locus of control in science, the males arrived and remained more committed to a science career than females.

There were significant differences by gender on the Science Attitudes Survey which was given as a posttest

only. The females were significantly more positive than males on attitude toward women in science, competition in science with the opposite sex, and their feelings about success in science. Overall, females were more positive than males.

In the final chapter the results, are discussed as related to the literature and conclusions drawn. Also covered are the implications of the study, limitations and recommendations for further research.

CHAPTER V
CONCLUSIONS

This study was designed to describe possible differences between academically talented male and female high school participants before an intensive science experience on three dependent variables; science-related attitudes, science locus of control, and commitment to a career in science. Gender differences in prior science-related experiences were also investigated. A major focus was to determine if the academically talented adolescent's perceptions and aspirations related to science study and careers were affected by the intensive science experience. A secondary focus was to determine if the effect varied by gender.

Discussion

Hypotheses relating to differences between males and females before the intensive science experience focused on science-related attitudes, science locus of control, commitment to a career in science, and prior science-related experiences. For overall science-related attitudes at the beginning of the experience, the differences between

academically talented male and female participants were significant. An analyses of responses to the seven TOSRA subscales was conducted. Unlike Fraser's (1979) conclusion that the subscales were seven independent factors of science-related attitudes, a high correlation was found to exist among the seven subscales. The difference could be based on the fact that initial development of the instrument was determined on an heterogeneous sample of junior and senior high students. Students of high ability who are interested in science could have interpreted the instrument questions from a different perspective. Gender differences were nonsignificant in the students' responses to the individual seven TOSRA subscales.

Before the experience, significant differences were not found for locus of control in science and career commitment to a science career. It was predicted from the literature (Addison, 1981; Dweck, 1975), that differences in locus of control in science between males and females would exist prior to the science experience. Females would tend to have a more externalized locus of control than males in a traditionally male-oriented field as science due to the traditional sex-role stereotyping at home and school and by society (Hollinger & Fleming, 1984; Reis, 1987) that encourages an external orientation. As a result of such

conditioning, females have tended to attribute their failures to an internalized lack of ability and successes to external events and forces. Inversely, males have tended to attribute successes to their internal abilities and failures to external causes.

According to the literature, females have not had as strong career interests and career commitment in science as males. Even females interested in the sciences have not been as clear about their goals as males (Malcolm, 1988). Thus, these particular results of no significant differences were not supported by the literature. However, the present results may not be applicable to previous research. Reis and Callahan (1989) warned against applying research on the general population of females to the gifted and talented population of females. Bright females have been determined a special population with differentiated characteristics (Callahan, 1979; Reis, 1987; Silverman, 1986) from the general population of females.

Overall differences in prior science-related hands-on and encouragement-related experiences were statistically nonsignificant although mean differences were slightly higher for males. It was predicted (Fox, 1979; Kahle & Lakes, 1983; Kahle, 1987; Malcolm, 1988) that a significant difference would exist in favor of males since females have

reportedly had less opportunity than males to play with toys and engage in activities in and out of school that are related to science or math. Thus, the finding of nonsignificant gender differences in the overall results of prior experiences is not consistent with previous studies.

The variance in individual responses regarding prior experiences indicated that boys, in agreement with the literature, preferred and played more often with toys related to science and math ability than females. Boys liked and played more often with blocks, electronic games or computers, and miniature figures, and engaged more often in action game activities than females. Females, on the other hand, favored and played more frequently with board games, crafts and puzzles. Interestingly, although males reported sports as a favorite activity, females stated that they engaged in sports activities more often than males. This variance was not determined in the previous literature reviewed.

In contrast to the literature, among individual science experience items, females had a higher frequency on most school-based science experiences listed. Whereas males reported a higher frequency in the opportunity during school to make robots and build machines, females stated more often than males that they experienced working in

science labs and conducted experiments. Sixty-two percent of the males reported building something that worked while 40% females reported building something that worked. Science fair participation was described by 90% of males and 83% of females. Females participated more often in science fairs in fifth grade while more males stated that they were involved in science fairs in grades sixth through ninth. Males and females said they engaged equally in science fairs in 10th and 11th grades. Although overall gender differences in prior hands-on experiences were not significant, the individual items indicated variance in experiences between males and females.

In Chapter Two it was reported that females received less encouragement to pursue science as an interest and eventually a career (Fox, 1977; Kerr, 1983, and others). Parents, teachers, counselors and other significant adults have often encouraged boys more than girls, perceiving them as more inclined in math and science (Fox, 1977). Males have benefitted more often than females from the many male role models in science who have encouraged them (Sanders & Stone, 1986). The results of nonsignificant gender differences in prior science-related encouragement experiences contradicts the literature since it would be expected that males would have significantly higher scores.

However, a trend in participant responses regarding encouragement revealed that males were encouraged more often by fathers, older adults, scientists or mentors and peers, while for females, mothers and teachers were people who encouraged their interest in science.

The fact that in this study females reported receiving encouragement from mothers and teachers is promising despite what has been reported in the literature about females not receiving adequate encouragement. It appears from this study that academically talented females interested enough in science to participate in an intensive science experience are different from the general population of females. They are also different from the gifted females discussed in the literature who received little encouragement despite their early interest in science.

After the intensive science experience there were no differences between males and females in science-related attitudes as measured by the Test of Science-Related Attitudes. However, attitudes changed significantly for all students. Mean scores on subscales were lower on post test scores than pretest scores. Only females changed in a positive direction in their views of scientists as normal people. Whereas males had entered the intensive science

experience with more pronounced attitudes toward science than females, at the end of the experience both males and females did not demonstrate a significant difference in attitudes. It appears that the treatment became an equalizer between males and females for this variable.

These results are in contrast to the prediction based on the literature that gender differences would exist after the intensive science experience in favor of females on all variables because females would have more to gain (Chipman & Thomas, 1987; Kahle, 1984; Malcolm 1988). The only positive change in attitudes was females' view of the normality of scientists. Kahle (1984) reported that females often view science as a masculine domain usually because they have had fewer female role models in science. Related is the perception that scientists are odd and work in isolation from other people (Farmer, 1987). Apparently, the opportunity for female participants to work along side a scientist in a lab on research for eight weeks and to attend a variety of workshops and lectures at which different kinds of scientists presented ideas, may have had a stronger influence on female participants than on males. To participate in an intensive science experience with other adolescents interested in science may have helped students realize that other female students like themselves

would perhaps be future scientists. Female participants gave spontaneous, informal feedback about the value of the interaction with peers and scientists in the science experience. They reported that stereotypical images of scientists were reduced through daily work in labs. Females stated that for once they had a peer group similar to themselves and this affected them positively.

For locus of control in science there were no gender differences or changes for participants as a result of the intensive science experience. The results were unexpected. It was predicted that an intensive experience that provided key factors in the development of science competencies would enhance females' internalized perceptions of abilities in science. Males and females entered the science experience with moderate levels of internal locus of control in science and did not change significantly as a result of the experience. The lack of change may be due to the complexity of the construct of science locus of control and the factors needed to influence change. One experience in late adolescence may not be enough. The lack of gender differences in science locus of control before and after the intensive experience are in contrast to the literature in which researchers have described females as more externally controlled in their beliefs of personal ability

than males. In this study, academically talented females, motivated to attend an intensive science experience may be more internally oriented in beliefs about ability than females in the general population, and more similar to academically talented males than described in the literature.

The intensive science experience did not appear to affect females' commitment to a career in science. Males and females differed significantly after the experience. Males demonstrated a higher level of commitment than females. These results are in agreement with past studies indicating that males are more interested and committed to pursuing careers in science than females.

The second attitude measure, Science Attitudes' Survey, given solely after the experience showed significant overall attitude differences between males and females. Significant differences between males and females were determined on three subscales; attitude toward women in science, competition in science with the opposite sex, and feelings about success in science. All significant differences were stronger for females. Mean scores between males and females on the scales, perceptions of parental encouragement to succeed in science, confidence in and enjoyment of science, and teacher's confidence in student's

abilities did not differ significantly although scores were slightly higher for females. Peer's feelings about science was a subscale in which mean scores were slightly higher for males. Male participants apparently reported feeling more supported in science by their peer group than females, although females indicated through informal feedback their positive feelings of peer support, often for the first time.

These findings are interesting in relation to the literature. As described in Chapter Two, females have often felt rejection from peers for taking advanced math or science courses (Fox, 1978). They have not been encouraged by teachers in math and science to the same degree as males (Sanders & Stone, 1986). As a result, females have not felt as oriented to success in science to the degree that males have (Chipman & Thomas, 1987). The results based on this measure are promising. The instrument was developed to be gender sensitive and may have a higher validity for female responses (Matyas, 1985) than other instruments, including the Test of Science-Related Attitudes. Positive science-related attitudes have been found to be related to pursuing a career in science (Kahle & Matyas, 1986; Koballa, 1982; Malcolm, 1986; Troost & Simpson, 1988). Thus, for females to feel more positive than males about

science on this measure may indicate a probability that they may continue into more formal study of science.

Implications

The results of this study contribute to a set of characteristics that describe academically talented males and females interested in science. The data from this study indicated that although overall gender differences did exist before the intensive science experience on science-related attitudes, as measured by the TOSRA, differences did not exist after the experience. The treatment appeared to equalize the differences between males and females.

The treatment did not affect attitudes positively as measured by the TOSRA except for females' view of scientists as normal. Mean scores actually went down. This could have happened because students were exhausted the last day of the program when they took the posttest instrument. Perhaps if reflection time were planned and posttests given after they returned home, a different set of scores may or may not have resulted. Another interpretation could include the fact that intense exposure to science may have reduced students' interest in science as a career path. Many students may have realized what

actually was involved in scientific research and found it did not appeal to them.

The fact that females' perceptions of scientists as normal people changed in a positive direction as a result of the experience has interesting implications. Perhaps the time spent in close proximity to scientists allowed females to realize that scientists are not such unusual people. As previously stated, females tended to informally report the positive social impact of the program. Meeting other male and female peers and perhaps also adult scientists helped them realize that they themselves were not so different and unusual for their interest in science. To find a peer group and to develop friendships with others interested in science may have contributed to their view of scientists as typical people.

The fact that the treatment did not affect career commitment in science and that males arrived and remained more committed to science as a career path indicated that either the instrument did not adequately assess the career interests of females or that the treatment did not effectively enhance females' career commitment. These implications suggest that another approach to measuring and intervening to encourage talented females to continue in science studies is warranted. Perhaps a more appropriate

methodology is the qualitative approach of structured or indepth interviews. Assessing females' perceptions of science directly may reveal more realistic information than relying on instruments that may or may not measure the experiences and views of females.

Although the treatment offered the opportunity for hands-on experiences with science and much information about science, there was not opportunity for personal exploration through career counseling. A direction in future research could be to alter the treatment so that regular counseling groups could be included. Group counseling sessions could focus directly on attitudes towards science, locus of control in science and career commitment in science. Both males and females may benefit more positively when able to personally explore their views of science, and their personal beliefs and values regarding a lifestyle as a scientist. As discussed by Kerr (1983) and others, gifted and talented adolescents often experience a feeling of being overwhelmed at all the career options they are capable of pursuing. The case of multipotentiality can cause problems in career decisions. Kerr (1983) concludes that especially females need to explore their values in relation to choosing a career. Including an affective component for career exploration in

an intervention that also includes exposure to and practice in scientific research could be an effective catalyst in the career development of academically talented females.

Gender differences in favor of females did result when measured by the SAS after the experience. Matyas (1985) developed the instrument for research purposes to investigate the factors involved in the attrition patterns of female college biology majors. The instrument includes seven subscales each measuring factors included in the literature pertaining to females entering and not entering science careers. The results of the measure in this study indicated overall significant gender differences as well as significant differences in favor of females on three scales. Using the instrument together with the TOSRA or another attitude measure in a pretest-posttest design may provide additional information regarding sensitivity of the SAS toward females' views of science.

The results of this study have implications for other directions in research and educational programming needs for academically talented females. Another approach to take in the research would be to develop a model regarding what type of academically talented and gifted female may have potential to become interested in and committed to a career in science. To develop this model it would be

valuable to ascertain scientifically-oriented-talented-females' perceptions of early play experiences, family experiences, school experiences, and future aspirations as they relate to science interest. The methodology of interviews could provide a broader and more indepth amount of information about developmental patterns and the importance of particular experiences.

Additionally, sorting bright females who are motivated enough in science to attend an advanced science program such as the Student Science Training Program, by personality type and then correlating types with personality variables such as the ones investigated in this study, could offer valuable information. Personality types could be correlated with levels of interests, achievement, experiences, goal clarity and attitudes to determine which types are associated with being at risk for not continuing in science and which types are associated with motivation to continue in science studies. The result of this kind of investigation might describe a profile of the able female who has potential for commitment to a science career and who needs intensive science experiences at critical times in their development in order to be encouraged to continue in science.

Another approach to investigating the nature of female scientific talent would be to study the perceived characteristics of people who have reportedly influenced successful women in science during their formative years. This kind of study could provide insight regarding the characteristics of influential mentors and significant people who make a difference in the lives of bright girls.

Essentially, the value of studying females in depth verses looking at gender differences would seem beneficial in the future. Women's development as it relates to science may be different than males' development as indicated to a limited degree in this study. If women's development is different, the separate needs of females may require different educational programs than males.

Development and evaluation of educational programs based on the needs of bright females at different stages in females' education are necessary. As reported in this study, the pattern of science fair participation by girls indicated that involvement is high at preadolescence in fifth grade but drops as compared to males in middle school and ninth grade. Involvement picks up again in 10th and 11th grade. It is not known which females completely lose interest in science during middle school and do not even reappear to participate in science fairs in 10th grade.

Investigating ways of encouraging bright girls at the middle school level would be an important contribution. Interventions based on results reported in the literature would need to be peer oriented, stress hands-on activities, and involve real-life problems.

Limitations

The study has several limitations to generalization. As reported in Chapter One, one limitation was the geographic population from which this sample was drawn. Another limitation was the type of students included in the sample. Participants in the study were those who were motivated to apply to the Student Science Training Program and attend an eight week intensive science experience away from home. Therefore, the findings of the study can only be generalized to older adolescents with a strong interest in science who are academically talented, as indicated by their high PSAT scores and high grade point averages in math and science. Caution should be made in overgeneralization to all women. The results need to be qualified and generalized only to females who would have the potential to qualify for and then opt into an eight-week intensive science experience.

The study was also limited by the instruments used. These instruments are new and lack extensive reliability and validity data. As self-report measures, they may have reflected the biases of the students' self-perceptions. Most of them may also have not been as sensitive to the culture of females in order to validly measure their experiences. The Science Attitude Survey appeared most sensitive to females' experiences and perceptions in science. Using this instrument as a pretest and posttest measure would have strengthened the study. Also, the addition of a qualitative component of interviewing participants to assess the affect of the intervention in the dependent variables may have provided more valid information about females' personal views of the intensive science experience.

Finally, as previously mentioned, the intervention lacked a personal focus on career development. It may have been more advantageous to substitute some of the scheduled scientific content for personal exploration of the values and lifestyle aspects of being a scientist.

Conclusion

The scientific talent pool in the United States needs to be increased to assure that there will not be a lack of

qualified scientists in the future. Women have been underrepresented in the science-related fields. The disparity between males and females in science appears to begin in early adolescence. It is important to understand female developmental and educational experiences to determine ways to encourage interested females to remain in science-related career tracks. This study investigated the gender differences of important factors in the development of career interest in science. The influence of an intensive, field-based science experience was studied to determine the differential affect on academically talented male and female students. The results indicated that males and females entered the program with differing attitudes towards science, with males more positive than females. After the experience, participants differed by gender in their commitment to a career in science and also in their attitudes towards science. Males arrived and continued to be more committed to a science career than females. The intensive science experience also appeared to have an equalizing effect on male and female attitude differences as measured by the Test of Science-Related Attitudes. The only positive attitude change as a result of the treatment was in females' view of scientists as normal people. On a second measure of science attitudes given solely after the

science experience, females were more positive towards science than males. Thus, the treatment did not directly affect the participants positively overall as determined by the instruments used in this study. Instead, only gender differences were evident before and after the intensive science experience.

Future studies are needed to investigate academically talented females' developmental needs as they apply to scientific talent. Appropriate experiences similar to the one investigated in this study need to be developed further and tested for effectiveness at varying developmental stages to determine if gifted and talented females interested in science can be encouraged to develop their potential and remain in the pool of future scientists so needed in the United States.

APPENDIX A

INTENSIVE SCIENCE EXPERIENCE

Detailed Schedule

31st Annual Student Science Training Program at the University of Florida
June 18 – August 12, 1989

Administered by the Florida Foundation for Future Scientists

Sponsored by State Department of Education
Summer Camps in Mathematics, Science and Computers

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Florida Foundation for Future Scientists Purpose and Objectives

The Florida Foundation for Future Scientists (FFFS) is a statewide, non-profit organization authorized by the 1957 Legislature of the State of Florida to discover scientific and technical talent in the schools of Florida and to encourage the pursuit of careers in science and engineering. In meeting its obligations, the Foundation promotes and administrates the following:

- Florida State Science and Engineering Fair
- The establishment of Guidelines, Rules and Procedures for local, regional, and statewide competitions
- The awarding of Scholarships and Prizes
- The coordination of Industrial, Professional, and Educational Activities related to careers in science and engineering
- Science and Engineering Youth Programs

The three major programs of the Florida Foundation for Future Scientists are the Annual Florida State Science and Engineering Fair, the Florida Junior Science, Engineering and Humanities Symposium, and the Student Science Training Program.

The FFFS is housed at the University of Florida and is provided partial direct support by the Provost through the Office of Academic Affairs. Major programs and operating expenses are financed by grants and contributions from federal agencies, the State Legislature, private industry, businesses, professional organizations, and individuals.

Program Description

NARRATIVE DESCRIPTION OF ONGOING SSTP

Approximately 120 high-ability, gifted and academically talented eleventh grade students are invited each summer to attend an eight-week residential research participation program at the University of Florida. This program is designed to provide participants with science and engineering opportunities beyond or other than those normally available at their high schools. An individual track is formulated for each participant, centering primarily around laboratory research participation.

A) PARTICIPANTS

1) Description of Participants

Students considered eligible for the SSTP are eleventh grade students (when they apply) who have been designated as gifted by State of Florida Department of Education criteria or who have demonstrated outstanding academic talent in high school. A provision for acceptance to the program stipulates that students must want to attend such a program and must be willing to work hard for eight weeks in a residential situation.

2) Criteria for Selection

Candidates are ranked by a University of Florida faculty panel which evaluates school nomination form, student form, high school transcript with standardized test scores, essay and letters of recommendation. Most applicants are qualified, but invitations are issued in the order of highest assigned rank with geographic distribution taken into consideration. Alternates also are ranked.

3) Scholarships

Qualified candidates are issued invitations regardless of their ability to pay the essential program expenses. Some eligible candidates are funded wholly or partially by contributors, or they are self-funded. Many students receive partial scholarship funding from more than one source. Once students are accepted to the program, individual funding "packages " are assembled. Scholarship funding is requested on behalf of the students, depending on availability of funding, student merit, geographic location, and indicated financial need.

B) PROGRAM CURRICULUM

Program, Reunion, Alumni, Professor and Administrative evaluations of the UF-SSTP, result in integral changes and improvements Its operation is based on a formula of balanced activities and challenging opportunities. Students are able to increase academic performance in response to an accelerated curriculum and schedule. For that reason, student instructional contact hours are increased from the statewide high school average of 300 minutes per day to a program average of 480 minutes per day; students attend scheduled academic activities an average of about 50 hours per week. Scheduling establishes a structure wherein participants are able to attain program goals and objectives.

The program consists of two major parts:

1) Laboratory and Academic Research Participation

During the SSTP, each professor sponsors a student who is assigned to work with him/her approximately 25 hours per week. The professor's responsibility is personally to see that the student has a "good research experience." In as far as possible, students are matched with professors working in research areas of interest to the student.

If not assigned to a project specifically designed for the SSTP, the student assists with the ongoing work of the lab. Students become familiar with sophisticated laboratory equipment often available only at an active research facility. More than half the student's workday time is spent in the laboratory. This experience helps define the meaning of research for the student and encourages subsequent efforts.

The research projects are the basis for professional-level research papers and oral presentations. Brief reaction papers commenting on lectures and seminars are prepared one time during the program by each student. The research project poster session provides an additional opportunity for students to present their research findings. Sessions are juried by peers and staff, with top students recognized and recommended to the Directors of their Regional Science and Engineering Fairs, District Superintendents, Science Supervisors, and Centers for Excellence.

Program Description

Each participant is required to prepare the following items relative to the individual research project:

(a) Weekly laboratory work log
(b) Written research plan and research certification forms
(c) Prospectus and interim bibliography
(d) Four-minute midterm oral presentation
(e) Abstract and final bibliography
(f) Research project poster and display
(g) Final written research paper
(h) Eight-minute final oral presentation
(i) Written reaction paper referring to a program lecture

2) Orientation to Science and Engineering Fields

Students attend the following activities and events:

(a) Lecture/Demonstration/Discussion Sessions (six hours weekly, some optional)
(b) Classes in Statistics or Computer Programming (four 60-minute sessions weekly)
(c) Educational Field Trips within Florida (four or five to different locations around the state)
(d) Seminars, Workshops and Special Activities (one or two 90-minute sessions each week)
(e) "Special Days" to visit the facilities and faculty of University of Florida Colleges, Schools, Centers and Departments (four or five sessions during the eight-week program)
(f) General Sessions (twice weekly 45-minute meeting for information and instruction)
(g) Study Groups (2 hours weekly as a group and individual meetings with study group leaders)

The Lecture Series is designed to expose participants to the many academic areas open to study. Participants attend lectures on Monday, Wednesday, and Friday mornings and work on their laboratory assignments during the afternoons. Eminent University professors and other professionals are invited to present interesting and timely topics. Five or six 50-minute lecture/discussion/question periods are held weekly. Students are encouraged to take notes and to retain hand-out materials in order to speak more effectively to their own groups after returning home.

Attendance in a college class is required of all students. Classes in Introductory Statistics, Mathematics and Programming, and Computer Programming in BASIC are offered. Dual Credit enrollment is available for students attending Florida High Schools in counties where an articulation agreement with the University of Florida has been signed.

Field trips for the SSTP are planned for the best educational experience possible. The trips provide on-site opportunities for students to substantiate information presented in other facets of the program. The logistics and planning necessary to move 100+ participants and staff members to various locations around the state are complex and require a great deal of cooperation from the participants to make the plan work as a whole. Field trips require many hours of detailed planning to arrange for the inclusion of as many educational items as possible during the limited time available at each location (and to make the best utilization of limited financial resources). Students participate in planning food arrangements and cleaning up the location.

Seminars, Workshops and Special Activities are scheduled to provide in-depth or hands-on experiences which would not be available during the normal class or lecture session. Seminars on different techniques in writing and research are among the special sessions offered.

The "Special Days" series includes visits to major research labs or specialized facilities on the University campus. These planned sessions include the College of Engineering, Departments of Physics and Astronomy, The College of Pharmacy, the College of Medicine, and the Institute of Food and Agricultural Sciences. Usually a session called a "Special Day" is held each week, either on a Friday morning or weekday evening. These "exploration" sessions continue at intervals throughout the SSTP.

General Sessions with SSTP Administrative Staff are scheduled to disseminate information and discuss activities. Deadlines and criteria for all academic requirements, special instructions on assignments, and briefings on field trips are examples of topics covered. Program evaluations are completed by participants during these sessions.

Students are assigned to small peer Study Groups where they share their research experiences and become acquainted with the work of others. Peers are encouraged to communicate academically in a motivating exchange of ideas. Study Groups allow participants to interact socially and academically as they survey a variety of research projects and other program activities. Planned Study Group activities include: reaction papers; presentations and group discussions of lectures, seminars, field trips and other academic activities; practice sessions for oral presentations; peer advice/discussions of individual projects and drafting sessions for prospectus, abstract and

other required written material. There are study periods and orientation sessions in various libraries and other UF facilities.

C) SUPPLEMENTAL SERVICES

1) Residence Hall Life

Students are housed in Beaty Towers for the duration of the eight-week residential program. Girls are housed on separate floors from boys. Students are paired with compatible roommates and suitemates.

Full floors are reserved solely for SSTP use. Only authorized University personnel and SSTP staff are permitted on student floors. In that atmosphere, participants develop long-lasting friendships and learn to live and to work with a diverse group of individuals. Sports and organized social activities add to the cohesiveness and spirit of the group.

Program staff are housed in the same areas to ensure adequate supervision. Students are expected to demonstrate a high degree of self-discipline. They are treated as young adults and are expected to conduct themselves accordingly. Rules of conduct, appropriate dress, and "curfew" are strictly observed for the well-being of the students and the reputation of the program.

Participants are given weekly stipends (in cash) from the FFFS toward basic food expenses during the program. The amount has proven adequate for participants who shop economically and cook most of their own meals. They manage their own finances. Staff members present workshops about housekeeping, laundry, and cooking. There are kitchens in each suite and camaraderie develops as participants learn to cope with living arrangements, roommates and program responsibilities.

2) Social and Recreational Activities

This list is a sample of the types of activities which are coordinated encouraged and/or monitored by SSTP staff and participants to augment the academic program activities: running/jogging groups, shared dinners, pizza parties, ping-pong, frisbee, softball and volleyball, etc. Program Orientation and Staff/Participant Introduction, Campus Walking Tours, Pool Parties, Pot-luck Suppers, Ice Cream Sundae Socials, Afternoon and Evening Movies, SSTP Skating Party, Roman Toga/Dinner Party, Student-Professor Reception and Dance, UF Outstanding High School Scholars (OHS) Program Banquet, OHS Dance, and Final Banquet and Dance.

3) Counseling and Academic Advisement

The Residential staff lives on residence hall floors with participants, supervising participant activities and offering personal counseling. Residential counselors also monitor academic progress carefully.

Program staff visit students and professors in labs three times at specific intervals, review weekly laboratory work logs, and assist students in solving problems. Weekly and bi-weekly class grades are checked and students are advised or tutored as necessary. Program staff members attend all classes and lectures to assist the instructors and invited speakers. In addition to seminars on public speaking and technical writing, interim evaluations are made of the prospectus, bibliography and midterm oral presentation of the research projects. These evaluations are reviewed with each student to encourage self improvement.

4) Student Career Information

Students are asked to indicate career and life goals upon application to the program. Subsequent interviews, combined with next-year questionnaire follow-up information and correspondence, attest to the strengthening of individual goals directly attributable to having participated in the SSTP.

Students are exposed to many professions and career options in their labs, through contact with professors and graduate students, and through the lecture series. College application procedures and Financial Aid application procedures are also discussed in the lecture series.

Participants are encouraged to correspond with the Director in regard to future plans as well as to make suggestions for program improvement. Alumni research indicates that participation in the SSTP plays an important role in the students' academic decisions and career choices.

5) Participant Health Services

Insurance for participant medical care during the SSTP is provided under the Florida state-wide insurance policy for summer camps. Two notarized Medical Information and Consent forms are required for each participant: one to be on hand for field trips, and another to have at the residence hall. A Health Counselor oversees medical treatment procedures and is responsible for maintaining first aid supplies in the Residence Hall.

Program Description

6) Orientation

The Plenary Convocation is the first General Session of the program. Staff are introduced and participant and parent questions are answered. The initial Orientation Session is held later the first night to introduce students to each other and to the staff. Weekly residence hall floor meetings also begin the first night. Students are officially welcomed to the University the following morning and are escorted on campus tours. During the program, colleges and departments also host group visits and other introductory sessions

D) SPECIAL FACILITIES, EQUIPMENT AND MATERIALS

All UF facilities, with the exception of the residence hall rooms, are provided at no cost to the SSTP. These include: office space and overhead for the FFFS offices; rooms used for lectures and classes; laboratories or other work space; auditorium space, rooms, and halls used for meeting sessions, study groups, seminars, special days and workshops. Sports facilities (including weightroom, gymnasium equipment, athletic fields, tennis and handball courts, and swimming pools) are available to students and staff.

Computer hardware and software used by participants during the SSTP are contributed, loaned or provided by UF, the Northeast Regional Data Center (NERDC), the Center for Instructional and Research Computing Activities (CIRCA), and the Department of Computer and Information Sciences (CIS). Included are IBM, VAX, Harris and Apple Computers.

Books required for class or coursework are loaned to the students by the SSTP. There are books and diskettes for computer courses, and texts for statistics. Participants are provided notebooks and paper with which to keep lecture notes. Many of the invited lecturers distribute handouts on the lecture topics. The materials are submitted in advance and are prepared and duplicated by the FFFS office.

Detailed daily and weekly schedules are distributed during the program. Activities, times and locations, invited speakers, assignment deadlines, and topics to be discussed are included. Field trip itineraries and maps are usually distributed to all participants prior to the trips to familiarize them with objectives and anticipated schedule. Schedules also include descriptive materials provided by the facilities to be visited.

More than 100 separate research laboratories or facilities within the colleges and departments of the UF are being utilized during the SSTP. The professionals contribute the use of their facilities, equipment and, most importantly, their time and guidance to the students. Millions of dollars worth of equipment is made available to the SSTP participants; it is impossible to duplicate the level of beneficial support anywhere other than a large active research facility.

E) POST-PROGRAM ACTIVITIES

Post-Program activities are required to evaluate the attainment of objectives. These vary depending upon the school, family, and community environment to which the student belongs.

The participants are given opportunities to develop science and math skills which will serve them well throughout their lives. They also become more articulate in their research areas and are encouraged to speak easily and converse intelligently about their projects. They advance appreciably in their writing abilities and carry this skill with them when they return home. Each constructs or prepares a poster or display of his or her project which is suitable to be entered in or adapted for future science and engineering competitions.

Students are sometimes asked to lecture to science and mathematics classes at their high schools or to service clubs and other community meetings. Talking about experience in research not only educates lay people involved, but also enables students to gain confidence in communication skills.

Following the program, supervising professors sometimes incorporate the students' results, reports, and other contributions into professional papers and presentations. Often, the participants continue their work and improve the projects begun during the SSTP, going on to submit papers and to make oral presentations of the research.

Events such as the Florida Junior Academy of Science/Florida Science Talent Search, the National Westinghouse Science Talent Search, the Florida State Science and Engineering Fair, the Junior Engineering Technical Society, the International Science and Engineering Fair, the Florida Junior Science, Engineering and Humanities Symposium and the National Junior Science and Humanities Symposium are avenues utilized by participants to gain recognition for their accomplishments.

SUNDAY, JUNE 18

10:00 AM - 2:00 PM **PROGRAM REGISTRATION** **BEATY TOWERS COMMONS**

Please register with the program and check into the residence hall. The time after participants have checked in and the time in the early evening after the convocation are free to get settled into rooms and to get to know roommates, suitemates, and other program participants. Participants are asked, however, to be prompt to the two scheduled events at 3:30 PM and 7:30 PM. Please bring notebooks to both sessions.

3:30 PM - 4:30 PM **31st SSTP CONVOCATION** **NORMAN HALL AUDITORIUM**

Parents and siblings are invited to attend this session. Refreshments will be available.

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

"Introductions of Staff and Counselors"	Dr. Elizabeth B Abbott, Director Student Science Training Program
"Introduction to SSTP Residential Life"	Mr. John W. Rhodes Associate Deputy Director Student Science Training Program
"Introduction to SSTP Schedule"	Ms Jacqueline S. Jamieson Program Coordinator Student Science Training Program
"Introduction to SSTP Academics"	Mr. Darrin L. Carr, Senior Counselor Student Science Training Program
"Introduction to SSTP Activities"	Mr. James Daniel Lee, Senior Counselor Student Science Training Program
"Scholarships and Funding Sources"	Mrs. Nina M. Dyer Admissions and Scholarships Coordinator Student Science Training Program

7:30 PM - 9:30 PM **PROGRAM ORIENTATION** **NORMAN HALL AUDITORIUM**

All participants are to gather at the elevators on their floors at 7:10 PM and go over to Norman Hall together (escorted by the counselors from their floors).

Presiding: Mr. John W. Rhodes, Associate Deputy Director, Student Science Training Program

"Introduction to UF Housing and Life at Beaty Towers"	Mr. Robert E. Bodnar, Jr. Assistant Residence Director UF Division of Housing
"Safety Awareness Seminar"	MJR Martha V. Varnes, Assistant Chief UF Police Department
"What's Different About Me"	All Participants and Staff

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

10:30 PM **FLOOR MEETINGS** **ASSIGNED FLOORS**

Participants meet by the elevators on their respective floors.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, JUNE 19

8:15 AM - 9:15 AM **UNIVERSITY WELCOME** **UF MEMORIAL AUDITORIUM**

Presiding and Opening Remarks: Dr. Elizabeth F Abbott, Director, Student Science Training Program

"Welcome to the University of Florida"	Dr. Gene W. Hemp Interim Provost, UF
	Dr. Gerald L. Zachariah Vice President of Agricultural Affairs, UF
	Dr. Patricia G. Webb Assistant Research Scientist Fruit Crops Department, UF
	Dr. Jacquelyn D. Hart Assistant Vice President for Minority Programs, UF

9:15 AM - 11:00 AM **OPENING SESSION** **UF MEMORIAL AUDITORIUM**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

"Review of SSTP—Week I"	Ms Jacqueline S. Jamieson Program Coordinator Student Science Training Program
"Review of SSTP Activities"	Mr. James Daniel Lee, Senior Counselor Student Science Training Program
"Introduction to Laboratory Participation"	Mrs. Nina M. Dyer Admissions and Scholarships Coordinator Student Science Training Program
"Introduction to Study Groups"	Mr. Darrin L. Carr, Senior Counselor Student Science Training Program
"Dual Credit Enrollment"	Dr. Elizabeth F Abbott, Director Student Science Training Program
"Choosing Your Class"	Mr. Jesse B. Smith, Classes Coordinator Student Science Training Program

11:00 AM - 12:00 NN **CAMPUS WALKING TOURS** **UF CAMPUS**

Study Group Leaders will escort participants on walking tours of campus.

1:00 PM - 5:00 PM **LABORATORY RESEARCH** **UF CAMPUS**

Study Group Leaders will escort participants to labs between 1:00 PM and 3:00 PM; participants are scheduled to stay in labs until 5:00 PM.

6:00 PM - 7:00 PM **SEMINAR** **L011 TURLINGTON**

"Cooking and Housekeeping Seminar"	Mrs. Wendy N. Sewell, Deputy Director Student Science Training Program
	Mr. Gary E. Torkington, Counselor Student Science Training Program

7:00 PM - 7:30 PM **GENERAL SESSION** **L011 TURLINGTON**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

"Study Group Assignments"	Mr. Darrin L. Carr, Senior Counselor Student Science Training Program

7:30 PM - 9:00 PM **STUDY GROUP MEETINGS** **TURLINGTON ROOMS**

Study Groups will meet in the following Turlington Hall rooms with Study Group Leaders:

1101—Microbiology/Immunology
Ms Karen T. Picquet, Ms Karin A. Provost

1105—Biology
Ms Stacey E. Beaulieu, Mrs. Nina M. Dyer

1315—Medicine & Health
Ms Heather E. Eyerly, Mr. William C. McElroy

1317—Medicine & Zoology
Ms Ameeta Ganju, Mr. John E. Dyer

1321—Engineering
Mr. James Daniel Lee, Mr. Travis W. Knight

2301—Computers
Mr. Brian D. Ray, Mr. Raymond F. Leitz

2303—Earth & Space Sciences
Mr. Derek M. Roberts, Mr. Wylie A. Mathis

2305—Psychology & Pharmacy
Ms Pola E. Sanchez, Mr. H. Edward Odom

2306—Materials Science & Chemistry
Mr. Gary B. Torkington, Mr. Omar Ahmad

10:00 PM **SIGN-IN AND STIPEND DISTRIBUTION** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

10:30 PM **FLOOR MEETING** **ASSIGNED FLOORS**

Participants meet by the elevator on their respective floors. Delegation representatives will be selected.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, JUNE 20

8:15 AM - 10:15 AM **CLASSES OVERVIEW** **215 LITTLE**

Presiding: Mr. Jesse B. Smith, Classes Coordinator, Student Science Training Program

Instructors for Statistics, Mathematics and Programming, BASIC, and Exploration of the Universe will answer questions and hold brief class sessions. Participants must choose a class by Sign-In Wednesday.

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

6:00 PM - 8:00 PM **SEMINAR** **215 LITTLE**

Presiding: Mr. Darrin L. Carr, Senior Counselor, Student Science Training Program

"Science Interest Assessment"
Ms Deborah Harris, Doctoral Candidate
College of Education, UF

8:15 PM - 8:45 PM **GENERAL SESSION** **L011 TURLINGTON**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

"Research Certification Forms"
Mrs. Nina M. Dyer
Scholarships and Admissions Coordinator
Student Science Training Program

8:45 PM - 9:45 PM **STUDY GROUPS** **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JUNE 21

7:45 AM — **LIBRARY ORIENTATION GROUPING** — **BEATY COMMONS**

Participants are to meet with their Study Group Leaders in Beaty Commons at 7:45 AM. Participants will be separated into two groups and will be directed to either the Central Science Library or the J. Hillis Miller Health Center Library. (Health Center Library group reports to C1-15 Communicore and the Central Science Library group reports to 107 Central Science Library.) The two groups will be escorted to the libraries by Study Group Leaders.

8:15 AM - 10:15 AM — **ORIENTATION TO UF LIBRARIES**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Introduction to J. Hillis Miller Health Center Library" — Ms Susan E. Woods, Associate Librarian, J. Hillis Miller Health Center Library, UF

Presiding: Ms Pola E. Sanchez, Counselor, Student Science Training Program

"Introduction to Central Science Library" — Ms Mona Leigh Mosier, Instructor Librarian, Central Science Library, UF

10:30 AM - 5:00 PM — **LABORATORY RESEARCH** — **ASSIGNED LABS**

5:30 PM - 6:30 PM — **AEROBICS—OPTIONAL** — **BEATY TOWERS REC ROOM**

7:00 PM - 9:00 PM — **SEMINAR** — **C1-15 COMMUNICORE**

"Word Processing for Scientists" — Mr. Jesse B. Smith, Classes Coordinator, Student Science Training Program

10:00 PM — **SIGN-IN** — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

10:30 PM — **FLOOR MEETINGS** — **ASSIGNED FLOORS**

Participants sign up for classes.

11:00 PM — **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JUNE 22

8:15 AM - 9:15 AM — **CLASSES** — **CLASSROOMS**

Classes meet in the following rooms: Statistics—215 Little, Mathematics and Programming—113 Little, BASIC—201 Little.

9:30 AM - 10:15 AM — **GENERAL SESSION** — **215 LITTLE**

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Students Science Training Program

Field Trip Scheduling, Briefing, and Assignments; Week 2 Scheduling; Delegation Party; Covered Dish Supper; Friday Lecture Series Sign-Up

10:30 AM - 5:00 PM — **LABORATORY RESEARCH** — **ASSIGNED LABS**

6:00 PM - 8:00 PM — **STATISTICS & COMPUTER LAB** — **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

8:15 PM - 9:15 PM — **STUDY GROUP MEETINGS** — **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM — **SIGN-IN** — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM — **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JUNE 23

8:15 AM - 10:15 AM **LECTURES**

Participants are required to sign up for either Lecture Series A or Lecture Series B and must attend that lecture series.

Lecture Series A — **211 MECHANICAL ENGINEERING BUILDING**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Biodiversity" — Dr. Walter S. Judd, Associate Professor Botany, UF

"Applications of Solar Energy" — Dr. Erich A. Farber, Director Solar Energy and Energy Conversion Laboratory, UF

Lecture Series B — **101 BUSINESS**

Presiding: Ms Pola E. Sanchez, Counselor, Student Science Training Program

"Quasars: Outposts of the Universe" — Dr. Alex G. Smith Distinguished Service Professor Astronomy and Physics, UF

"How a Nuclear Power Plant Works" — Dr. William G. Vernetson, Associate Engineer Nuclear Engineering Sciences, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — **ASSIGNED LABS**

8:00 PM - 10:30 PM **STUDENT DELEGATION PARTY** — **BROWARD POOL**

12:00 MT **SIGN-IN AND IN SUITES** — **ASSIGNED FLOORS**

SATURDAY, JUNE 24

7:00 AM - 12:00 MT **ST. AUGUSTINE FIELD TRIP**

See Field Trip Schedule and Information Sheet.

12:00 MT **SIGN-IN AND IN SUITES**

SUNDAY, JUNE 25

1:00 PM - 3:00 PM **SPECIAL INTEREST GROUPS—OPTIONAL**

6:00 PM - 8:00 PM **COVERED DISH SUPPER** — **BEATY COMMONS**

9:00 PM - 10:00 PM **ASTRONOMY LAB TOUR—OPTIONAL**

10:00 PM **SIGN-IN** — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

10:30 PM **FLOOR MEETING** — **ASSIGNED FLOORS**

SSTP participants will be introduced to the Future Leaders Seminar participants living on their floor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, JUNE 26

8:15 AM - 10:15 AM LECTURES — **215 LITTLE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Students Science Training Program

"Management and You" — Dr. Karl W. Kepner, Distinguished Service Professor, Food and Resource Economics, UF

"Education 2001" — Dr. Marilyn J. Maple, Coordinator of Educational Media, Learning Resources and Communications, J. Hillis Miller Health Center, UF

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

7:00 PM - 7:30 PM GENERAL SESSION — **L011 TURLINGTON**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Students Science Training Program

Prospectuses and Bibliographies; Reaction Papers; Certification Forms

7:30 PM - 9:00 PM STUDY GROUP MEETINGS — **TURLINGTON ROOMS**

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, JUNE 27

8:15 AM - 9:15 AM CLASSES — **CLASSROOMS**

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM PHILOSOPHY AND ETHICS FORUM — **215 LITTLE**

Participants will view a film about ethics in engineering entitled, "Gilbane GOLD."

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

6:00 PM - 8:00 PM STATISTICS & COMPUTER LAB — **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

8:15 PM - 9:15 PM STUDY GROUP MEETINGS — **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender. Participants planning to stay over the Independence Day Holiday who have not made previous arrangements with their floor counselor must do so at this time. The same procedure applies to participants who will not return from the holiday by 9:00 PM on Tuesday, July 4.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JUNE 28

8:15 AM - 10:15 AM LECTURES — **C1-15 COMMUNICORE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Interstellar Space Travel—Warp Nine" — Mr. William J. Cooke, Doctoral Candidate Astronomy, UF

"Report Writing" — Dr. Wayne A. Losano, Associate Dean of Student Affairs, Professor of English, College of Liberal Arts and Sciences, UF

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

5:30 PM - 6:30 PM AEROBICS—OPTIONAL — **BEATY TOWERS REC ROOM**

7:00 PM - 9:00 PM SEMINAR — **A101 COMPUTER SCIENCE ENGINEERING**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"The Ethical Leader" — Ms Mary Lynn Williamson, Assistant Dean for Student Affairs, UF

9:00 PM - 10:00 PM ICE CREAM SOCIAL — **BEATY COMMONS**

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JUNE 29

7:00 AM - 8:00 AM GROUP PHOTOGRAPHY SESSION — **UF STADIUM**

8:15 AM - 9:15 AM CLASSES — **CLASSROOMS**

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM GENERAL SESSION — **215 LITTLE**

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Week 3 Scheduling; Evaluations

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

6:00 PM - 8:00 PM STATISTICS & COMPUTER LAB — **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JUNE 30

8:15 AM - 10:15 AM LECTURE — **PERCY BEARD TRACK**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Introduction to the Parcours Fitness Trail" — Dr. Ruth Alexander, Professor, Exercise and Sports Medicine

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

5:00 PM **PARTICIPANTS DISMISSED—HOLIDAY**

Participants are to return Tuesday, July 4, by 9:00 PM. If a participant will not be back by this time, the floor counselor must be informed by Tuesday, June 27, at sign-in. Participants planning to stay over the weekend must have signed up on their floor by Tuesday, June 27, at sign-in. Have a safe and fun weekend!

SATURDAY, JULY 1 **INDEPENDENCE DAY HOLIDAY**

SUNDAY, JULY 2 **INDEPENDENCE DAY HOLIDAY**

MONDAY, JULY 3 **INDEPENDENCE DAY HOLIDAY**

TUESDAY, JULY 4 **INDEPENDENCE DAY HOLIDAY**

Participants must be back by 9:00 PM unless previous arrangements have been made with the floor counselor.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JULY 5

8:15 AM - 10:15 AM **LECTURES** **C1-11 COMMUNICORE**

Presiding Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Samuel Beckett's *Come & Go*" Dr. Sidney R. Homan
Professor of English, UF

"Karst and the Ichetucknee System" Mr. Nolan Col, Program Manager
Suwannee River Water Management District

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

5:30 PM - 6:30 PM **AEROBICS—OPTIONAL** **BEATY TOWERS REC ROOM**

7:00 PM - 9:00 PM **SEMINAR** **C1-15 COMMUNICORE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Write Well, Right Now" Dr. Ronald H. Carpenter
Professor of English, UF

9:30 PM - 10:00 PM **STUDY GROUP MEETINGS** **BEATY TOWERS**

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JULY 6

8:15 AM - 9:15 AM **CLASSES** **CLASSROOMS**

Participants in the Mathematics and Programming class will no longer meet in 113 Little. The new classroom is E222 Computer Science Engineering. The other two classes will meet in previously assigned rooms.

9:30 AM - 10:15 AM **GENERAL SESSION** **215 LITTLE**

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Field Trip Scheduling, Briefing, and Assignments; Study Group Social Activities; Week 4 Scheduling; Delegation Costume Party

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

6:00 PM - 8:00 PM **STATISTICS & COMPUTER LAB** **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

9:00 PM - 10:00 PM **STUDY GROUP MEETINGS** **BEATY TOWERS**

Participants are to meet with their study group leaders in Beaty Towers instead of in the usual Turlington rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JULY 7

8:15 AM - 10:15 AM **LECTURES**

Participants are required to sign up for either Lecture Series A or Lecture Series B and must attend that lecture series.

Lecture Series A — **103 BUSINESS**

Presiding: Ms Pola E. Sanchez, Counselor, Student Science Training Program

"Sports Medicine: An Introduction to the Art and Science"	Dr. Edward G. McFarland, Assistant Professor Department of Orthopaedic Surgery, UF
"Soils and Their Importance"	Dr. Mary E. Collins, Associate Professor Soil Science, UF

Lecture Series B — **211 MECHANICAL ENGINEERING BUILDING**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Languages of Engineering"	Dr. Robert B. Gaither Professor and Chairman Mechanical Engineering, UF
"PIXE: Pot-pourri"	Dr. Henri A. Van Rinsvelt, Professor Physics, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

8:00 PM - 11:00 PM **DELEGATION COSTUME PARTY** **BROWARD HALL REC ROOM**

12:00 MT **SIGN-IN AND IN SUITES** **ASSIGNED FLOORS**

SATURDAY, JULY 8

6:30 AM - 5:30 PM **ICHETUCKNEE/O'LENO FIELD TRIP**
See Weekend Field Trip Schedule and Information Sheet.

6:00 PM - 10:00 PM **STUDY GROUP SOCIAL ACTIVITIES**
Study Groups will each decide on a social activity for this time period with their Study Group Leaders.

12:00 MT **SIGN-IN AND IN SUITES** **ASSIGNED FLOORS**

SUNDAY, JULY 9

1:00 PM - 3:00 PM **SPECIAL INTEREST GROUPS—OPTIONAL**

3:00 PM - 5:00 PM **SSTP BOWL—OPTIONAL** **BEATY COMMONS**

7:00 PM - 10:00 PM **MOVIE PARTY** **OAKS MALL**
See Weekend Field Trip Schedule and Information Sheet.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**
Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**
After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, JULY 10

8:15 AM - 10:15 AM **LECTURES** **101 LITTLE**
Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Mr. Wizard: Chemistry in Action" — Dr. Martin T. Vala, Professor Chemistry, UF

"The Art and Science of Love" — Dr. Walter A. Busby, Associate Professor Education, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

5:30 PM - 6:30 PM **AEROBICS—OPTIONAL** **BEATY TOWERS REC ROOM**

7:00 PM - 7:30 PM **GENERAL SESSION** **L011 TURLINGTON**
Presiding: Mr. Darrin L. Carr, Senior Counselor, Student Science Training Program

Discussion of Poster Seminar and Midterm Orals

7:30 PM - 9:00 PM **STUDY GROUP MEETINGS** **TURLINGTON ROOMS**
Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**
Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**
After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, JULY 11

8:15 AM - 9:15 AM **CLASSES** **CLASSROOMS**

Participants in the Mathematics and Programming class will no longer meet in 113 Little. The new classroom is E222 Computer Science Engineering. The other two classes will meet in previously assigned rooms.

9:30 AM - 10:15 AM **PHILOSOPHY AND ETHICS FORUM** **215 LITTLE**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Students Science Training Program

"Great American Heroes: Ethics" — Dr. Patricia G. Webb, Assistant Research Scientist, Fruit Crops, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

6:00 PM - 8:00 PM **STATISTICS & COMPUTER LAB** **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JULY 12

8:15 AM - 10:15 AM **LECTURES** **C1-11 COMMUNICORE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Students Science Training Program

"Coloring Maps" — Dr. Bruce H. Edwards, Associate Professor and Associate Chair Mathematics, UF

"Diabetes Among African Americans: An Example of Bioculture" — Dr. Leslie S. Lieberman, Associate Professor Anthropology, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

5:30 PM - 6:30 PM **AEROBICS—OPTIONAL** **BEATY TOWERS REC ROOM**

7:00 PM - 9:00 PM **STUDY GROUP MEETINGS** **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JULY 13

8:15 AM - 9:15 AM CLASSES — CLASSROOMS

Please meet in previously assigned rooms. Mathematics and Programming class participants are reminded to meet in E222 Computer Science Engineering.

9:30 AM - 10:15 AM GENERAL SESSION — 215 LITTLE

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Field Trip Scheduling, Briefing, and Assignments, Week 5 Scheduling, Delegation Report, Evaluation II

10:30 AM - 5:00 PM LABORATORY RESEARCH — ASSIGNED LABS

6:00 PM - 8:00 PM STATISTICS & COMPUTER LAB — LAB CLASSROOMS

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM SIGN-IN — ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JULY 14

8:30 AM - 12:00 NN LABORATORY RESEARCH — ASSIGNED LABS

1:00 PM - 6:00 PM MIDTERM ORALS

Half of the participants will meet in 2319 Turlington and the other half will meet in 105 Fine Arts Building B. Participants should refer to the Midterm Schedule handout to determine the time they are to speak and in which room they are to speak.

6:30 PM - 7:30 PM AEROBICS—OPTIONAL — BEATY TOWERS REC ROOM

8:00 PM - 11:00 PM STUDENT DELEGATION PARTY — BROWARD POOL

12:00 MT SIGN-IN AND IN SUITES — ASSIGNED FLOORS

SATURDAY, JULY 15

5:45 AM - 3:00 AM MAGIC KINGDOM/EPCOT FIELD TRIP

See Field Trip Schedule and Information Sheet.

SUNDAY, JULY 16

1:00 PM - 3:00 PM SPECIAL INTEREST GROUPS—OPTIONAL

9:00 PM - 10:00 PM ASTRONOMY LAB TOUR—OPTIONAL

10:00 PM SIGN-IN — ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, JULY 17

8:15 AM - 10:15 AM LECTURES — **101 LITTLE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Students Science Training Program

"Newton and His Apple" — Dr. Frederick Gregory, Associate Professor History, UF

"Hacked Bones—Forensic Anthropology" — Dr. William R. Maples, Curator of Physical Anthropology, Florida Museum of Natural History

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

5:30 PM - 6:30 PM AEROBICS—OPTIONAL — **BEATY TOWERS REC ROOM**

7:00 PM - 7:30 PM GENERAL SESSION — **L011 TURLINGTON**

Presiding: Mr. Darrin L. Carr, Senior Counselor, Students Science Training Program

Discussion of Poster Seminar, Westinghouse Forms, Thank You Letters.

7:30 PM - 9:00 PM STUDY GROUP MEETINGS — **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

9:30 PM - 10:00 PM STUDY GROUP MEETINGS — **BEATY TOWERS**

Distribution of poster board and press type for Poster Seminar.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, JULY 18

8:15 AM - 9:15 AM CLASSES — **CLASSROOMS**

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM PHILOSOPHY AND ETHICS FORUM — **215 LITTLE**

Participants will view a film about ethics in medicine and health entitled, "Code Gray."

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

6:00 PM - 8:00 PM STATISTICS & COMPUTER LAB — **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JULY 19

8:15 AM - 10:15 AM LECTURES — **C1-11 COMMUNICORE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Students Science Training Program

"Using Audio-Visuals Effectively in Presentations" — Mr. John E. Dyer, Alumni Affairs Coordinator Student Science Training Program

"Applying Just-In-Time in a Water Fab: A Case Study" — Dr. Louis A. Martin-Vega, Associate Professor Industrial and Systems Engineering, UF

10:30 AM - 5:00 PM	LABORATORY RESEARCH	ASSIGNED LABS
5:30 PM - 6:30 PM	AEROBICS—OPTIONAL	BEATY TOWERS REC ROOM
9:30 PM - 10:00 PM	STUDY GROUP MEETINGS	BEATY TOWERS
10:00 PM	SIGN-IN	ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JULY 20

8:15 AM - 9:15 AM CLASSES — CLASSROOMS

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM GENERAL SESSION — 215 LITTLE

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Field Trip Scheduling, Briefing, and Assignments; Week 6 Scheduling

10:30 AM - 5:00 PM	LABORATORY RESEARCH	ASSIGNED LABS
6:00 PM - 8:00 PM	STATISTICS & COMPUTER LAB	LAB CLASSROOMS

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131E Architecture.

10:00 PM SIGN-IN — ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JULY 21

8:15 AM - 10:15 AM LECTURES — 101 LITTLE

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Greenhouse Effects"	Dr. Leon H. Allen, Associate Professor Agronomy, UF
"Memory Disorders and Brain Damage"	Dr. Russell M. Bauer, Associate Professor Clinical Psychology, UF

10:30 AM - 5:00 PM	LABORATORY RESEARCH	ASSIGNED LABS
5:30 PM - 6:30 PM	AEROBICS—OPTIONAL	BEATY TOWERS REC ROOM
8:00 PM - 11:00 PM	STUDENT DELEGATION PARTY	BROWARD HALL BASEMENT
12:00 MT	SIGN-IN AND IN SUITES	ASSIGNED FLOORS

SATURDAY, JULY 22

10:00 AM - 10:00 PM BEACH PARTY FIELD TRIP — DR. ABBOTT'S BEACH HOUSE

See Field Trip Schedule and Information Sheet.

12:00 MT SIGN-IN AND IN SUITES — ASSIGNED FLOORS

SUNDAY, JULY 23

1:00 PM - 3:00 PM	TALENT SHOW TRY-OUTS—OPTIONAL	MED CENTER AUDITORIUM
3:00 PM - 5:00 PM	SSTP BOWL—OPTIONAL	BEATY COMMONS
6:30 PM - 8:15 PM	UF OUTSTANDING HIGH SCHOOL SCHOLARS (OHS) BANQUET	RION BALLROOM, JWRU
8:30 PM - 11:00 PM	OHS DANCE	FLORIDA MUSEUM OF NATURAL HISTORY
11:30 PM	SIGN-IN AND IN SUITES	ASSIGNED FLOORS

MONDAY, JULY 24

8:00 AM - 9:00 AM	OHS HONORS PROGRAM PRESENTATION	JWRU AUDITORIUM
9:15 AM - 10:00 AM	OHS SCHOLARSHIP AND FINANCIAL AID SEMINAR	JWRU AUDITORIUM
10:30 AM - 5:00 PM	LABORATORY RESEARCH	ASSIGNED LABS
5:30 PM - 6:30 PM	AEROBICS—OPTIONAL	BEATY TOWERS REC ROOM
7:00 PM - 9:00 PM	POSTER SEMINAR	TURLINGTON ROOMS

Please meet in previously assigned study group rooms.

10:00 PM — SIGN-IN — ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM — IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, JULY 25

8:15 AM - 9:15 AM — CLASSES — CLASSROOMS

Please meet in previously assigned rooms.

9:30 AM - 10:30 AM — PHILOSOPHY AND ETHICS FORUM — 215 LITTLE

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

"International Business Ethics" — Dr. Roy L. Crum, Professor, Department of Finance, Insurance and Real Estate, UF

10:45 AM - 5:00 PM	LABORATORY RESEARCH	ASSIGNED LABS
7:00 PM - 9:00 PM	POSTER SEMINAR	TURLINGTON ROOMS

Please meet in previously assigned study group rooms.

10:00 PM — SIGN-IN — ASSIGNED FLOORS

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM — IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, JULY 26

8:15 AM - 10:15 AM LECTURES — **C1-11 COMMUNICORE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"The Art and Science of Love" — Dr. Walter A. Busby, Associate Professor Education, UF

"The American Economy" — Dr. David A. Denslow Chairman and Professor Economics, UF

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

5:30 PM - 6:30 PM AEROBICS—OPTIONAL — **BEATY TOWERS REC ROOM**

7:00 PM - 9:00 PM POSTER SEMINAR — **TURLINGTON ROOMS**

Please meet in previously assigned study group rooms.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, JULY 27

8:15 AM - 9:15 AM CLASSES — **CLASSROOMS**

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM GENERAL SESSION — **215 LITTLE**

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Field Trip Briefing, Scheduling, and Assignments; Week 7 Scheduling; Evaluation III

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

6:00 PM - 8:00 PM STATISTICS & COMPUTER LAB — **LAB CLASSROOMS**

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on the floors reserved for participants of their gender.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, JULY 28

9:15 AM - 10:15 AM LECTURES — **101 LITTLE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Unexpected Allies: Or How to Take Advantage of Your English Teacher" — Dr. Michael W. Raymond, Professor of English, Stetson University

10:30 AM - 5:00 PM LABORATORY RESEARCH — **ASSIGNED LABS**

5:30 PM - 6:30 PM AEROBICS—OPTIONAL — **BEATY TOWERS REC ROOM**

7:00 PM - 11:00 PM TALENT SHOW REHEARSALS—OPTIONAL — **MED CENTER AUDITORIUM**

12:00 MT SIGN-IN AND IN SUITES — **ASSIGNED FLOORS**

SATURDAY, JULY 29

10:00 AM - 1:00 PM GAINESVILLE AREA FIELD TRIPS

See Field Trip Schedule and Information Sheet.

1:00 PM - 3:30 PM REUNION PICNIC — **LAKE WAUBERG, NORTH**

See Field Trip Schedule and Information Sheet.

8:00 PM - 11:30 PM REUNION DANCE — **FLORIDA THEATRE**

See Field Trip Schedule and Information Sheet.

12:00 MT SIGN-IN AND IN SUITES — **ASSIGNED FLOORS**

SUNDAY, JULY 30

1:00 PM - 3:00 PM TALENT SHOW REHEARSALS—OPTIONAL — **MED CENTER AUDITORIUM**

3:00 PM - 5:00 PM SSTP BOWL—OPTIONAL — **BEATY COMMONS**

7:00 PM - 10:00 PM TALENT SHOW — **MED CENTER AUDITORIUM**

10:30 PM SIGN-IN — **ASSIGNED FLOORS**

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM IN SUITES

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, JULY 31

8:15 AM - 10:15 AM LECTURE — **101 LITTLE**

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Psychology Types of Students and Scientists" — Dr. Mary H. McCaulley, President, Center for Applications of Psychology Type; Ms Deborah M. Harris, Doctoral Candidate, College of Education, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — ASSIGNED LABS

5:30 PM - 6:30 PM **AEROBICS—OPTIONAL** — BEATY TOWERS REC ROOM

7:00 PM - 7:30 PM **GENERAL SESSION** — L011 TURLINGTON

Presiding: Mr. Darrin L. Carr, Senior Counselor, Student Science Training Program

Discussion of Final Papers and Final Orals

7:30 PM - 9:00 PM **STUDY GROUP MEETINGS** — TURLINGTON ROOMS

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, AUGUST 1

8:15 AM - 9:15 AM **CLASSES** — CLASSROOMS

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM **PHILOSOPHY AND ETHICS FORUM** — 215 LITTLE

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Student Science Training Program

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — ASSIGNED LABS

6:00 PM - 8:00 PM **STATISTICS & COMPUTER LAB** — LAB CLASSROOMS

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, AUGUST 2

8:15 AM - 9:15 AM **GENERAL SESSION** — C1-11 COMMUNICORE

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

Representatives from Army, Air Force, and Navy ROTC will provide information about ROTC opportunities at the University of Florida.

9:15 AM - 10:15 AM **LECTURE** — C1-11 COMMUNICORE

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Scientific Technical Writing" — Dr. James Nehiley, Associate Professor IFAS Editorial, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — ASSIGNED LABS

5:30 PM - 6:30 PM **AEROBICS—OPTIONAL** — BEATY TOWERS REC ROOM

7:00 PM - 9:00 PM **SEMINAR** — L007 TURLINGTON

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"The Research Game" — Dr. Parker A. Small, Jr., Professor Immunology and Medical Microbiology Pediatrics, UF

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, AUGUST 3

8:15 AM - 9:15 AM **CLASSES** — CLASSROOMS

Please meet in previously assigned rooms.

9:30 AM - 10:15 AM **GENERAL SESSION** — 216 LITTLE

Presiding: Ms Jacqueline S. Jamieson, Program Coordinator, Student Science Training Program

Week 8 Scheduling; Final Orals Scheduling

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — ASSIGNED LABS

6:00 PM - 8:00 PM **STATISTICS & COMPUTER LAB** — LAB CLASSROOMS

Statistics class lab will be in E222 CSE. APL class will have IBM PS/2 Model 50's available in 218 Bryan and BASIC class will have 37 IBM PC/XT's in 131B Architecture.

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, AUGUST 4

8:15 AM - 12:15 PM **LABORATORY RESEARCH** — ASSIGNED LABS

1:00 PM - 4:00 PM **RECEPTION PREPARATION** — DR. ABBOTT'S RESIDENCE

7:00 PM - 8:00 PM **PROFESSOR/STUDENT RECEPTION** — DR. ABBOTT'S RESIDENCE

8:00 PM - 11:00 PM **RECEPTION DANCE** — DR. ABBOTT'S RESIDENCE

12:00 MT **SIGN-IN AND IN SUITES** — ASSIGNED FLOORS

SATURDAY, AUGUST 5

Participants are encouraged to take advantage of unscheduled time to work on final papers and study for final exams.

6:00 PM - 6:30 PM **STUDY GROUP MEETINGS** — BEATY TOWERS

7:30 PM - 11:00 PM **SKATING PARTY** — SUN SKATE CENTER

A shuttle bus will take participants from Beaty Towers to Sun Skate Center. The first shuttle will take floors 4 and 7 at 7:15 PM, the second shuttle will take floors 5 and 8 at 7:30 PM, and the third shuttle will take floors 6 and 9 at 7:45 PM. At the conclusion of the skating party, a shuttle bus will leave Sun Skate Center to return participants to Beaty Towers. The first shuttle will take floors 4 and 7 at 11:00 PM, the second shuttle will take floors 5 and 8 at 11:15 PM, and the third shuttle will take floors 6 and 9 at 11:30 PM.

12:00 MT **SIGN-IN AND IN SUITES** — ASSIGNED FLOORS

SUNDAY, AUGUST 6

1:00 PM - 3:00 PM **SPECIAL INTEREST GROUPS—OPTIONAL**

6:00 PM - 7:30 PM **COVERED DISH SUPPER** — BEATY COMMONS

7:30 PM - 8:30 PM **ICE CREAM SUNDAE SUNDAY** — BEATY COMMONS

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

MONDAY, AUGUST 7

8:15 AM - 10:15 AM **CAREER FORUM** — 101 LITTLE

Presiding: Mr. James Daniel Lee, Senior Counselor, Student Science Training Program

"Careers in Pharmacy" — Dr. Michael W. McKenzie, Associate Professor and Assistant Dean for Student Affairs, College of Pharmacy, UF

"Women in Science" — Dr. Susan Suarez, Assistant Professor Physiological Science, UF

"Careers in Engineering" — Dr. Herbert A. Bevis, Professor Environmental Engineering Sciences Associate Dean for Academic Affairs College of Engineering, UF

10:30 AM - 5:00 PM **LABORATORY RESEARCH** — ASSIGNED LABS

7:00 PM - 7:30 PM **GENERAL SESSION** — L011 TURLINGTON

Presiding: Mr. Darrin L. Carr, Senior Counselor, Student Science Training Program

Discussion of Final Exams, Final Papers, and Final Orals.

7:30 PM - 9:00 PM **STUDY GROUP MEETINGS** — TURLINGTON ROOMS

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** — ASSIGNED FLOORS

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

TUESDAY, AUGUST 8

8:15 AM - 10:15 AM **FINAL EXAMS**

The final exam for Statistics will be in G086 McCarty, the final exam for BASIC will be in 1108 McCarty, and the final exam for Mathematics and Programming will be in 2196 McCarty.

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

7:00 PM - 9:00 PM **STUDY GROUP MEETINGS** **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

WEDNESDAY, AUGUST 9

9:30 AM **FINAL PAPERS DUE** **BEATY TOWERS**

Participants are to turn in their research papers to their study group leaders by 9:30 AM.

10:30 AM - 5:00 PM **LABORATORY RESEARCH** **ASSIGNED LABS**

7:00 PM - 7:30 PM **GENERAL SESSION** **L011 TURLINGTON**

Presiding: Ms. Darrin L. Carr, Senior Counselor, Student Science Training Program

7:30 PM - 9:00 PM **STUDY GROUP MEETINGS** **TURLINGTON ROOMS**

Please meet in previously assigned rooms.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

THURSDAY, AUGUST 10

8:15 AM - 6:30 PM **FINAL ORAL PRESENTATIONS**

One third of the participants will meet in 310 Larsen, one third will meet in 215 Little, and one third will meet in G086 McCarty. Participants should refer to the Final Orals Schedule handout to determine the time they are to speak and in which room they are to speak.

7:30 PM - 9:30 PM **PRELIMINARY ROOM CHECKS** **BEATY TOWERS**

Floor counselors will do preliminary room checks on an appointment basis between 7:30 PM and 9:30 PM. Before scheduled appointments, participants must have thoroughly cleaned the oven and refrigerator, checked the furniture condition, cleaned the bathroom and kitchen, removed posters, pictures, and tape from the walls, checked lamps, replaced burned out light bulbs, and vacuumed.

10:00 PM **SIGN-IN** **ASSIGNED FLOORS**

Participants must be signed in and present on their floor. Participants who wish to visit another floor of their gender must sign out with their floor counselor.

11:00 PM **IN SUITES**

After 11:00 PM participants are to remain in their suites until 7:00 AM the following morning.

FRIDAY, AUGUST 11

8:30 AM - 10:15 AM — **GENERAL SESSION** — **L005 TURLINGTON**

Presiding: Mrs. Wendy N. Sewell, Deputy Director, Students Sciences Training Program

10:30 AM - 5:00 PM — **LABORATORY WRAP-UP** — **ASSIGNED LABS**

6:30 PM - 7:00 PM — **RECEPTION** — **RION BALLROOM, JWRU**

7:00 PM - 12:00 MT — **AWARDS BANQUET AND DANCE** — **RION BALLROOM, JWRU**

Appropriate dress for the banquet and dance is dressy dresses or formals for the females and suits or jackets and ties for the males.

12:30 AM - 2:30 AM — **SLIDE SHOW AND PARTICIPANT FAREWELLS** — **137 NORMAN**

Refreshments will be available.

2:30 AM — **SIGN-IN AND IN SUITES** — **ASSIGNED FLOORS**

It is imperative that you sign in immediately following the slide show and participant farewells. There will be a mandatory "lights-out" at 3:30 AM. Counselors' rooms will be the only exceptions.

SATURDAY, AUGUST 12

8:00 AM - 12:00 NN — **CHECK-OUT** — **BEATY TOWERS**

Participants are to check out with their floor counselors according to a pre-arranged schedule. Sign-up sheets are posted on each floor for appointment times. Once the floor counselor has made the final inspection, the participant needs to drop off his or her keys at Beaty Desk in the Commons. At that time, the room condition form will be signed and the yellow copy returned. Participants must present this copy to receive an exit packet. Exit packets are distributed only to those who have completed the program (*i.e.*, returned all library books, paid all library fees, turned in all forms, papers, etc.).

We have found your dedication, perseverance, and hard work inspiring. As you carry the SSTP experience into your future, we hope you will remember the challenges, the adventures, the camaraderie, and us. We will miss you!

APPENDIX B

INSTRUMENTS

LOCIS II

Your Thoughts About Science

This an opinionnaire which helps us determine what different people believe about some matters related to science. The opinionnaire is composed of 18 statements with which you may agree or disagree. Since opinions differ, there are no "right" or "wrong" responses to these items. All of the possible responses are probably "right" to some degree, so it is usually a matter of picking those that seem "most right" to you personally.

Please indicate your response to each item on the response sheet provided. Circle one of the five choices on the response sheet next to the number for each item to indicate your agreement or disagreement.

Here is an example:

College students have too much free time. SA A N D SD

Circling the SA means that you "Strongly Agree" with the statement.
Circling the A indicates that you "Agree" somewhat with the statement.
Circling the N shows that you have either no opinion or a neutral feeling about the statement.
Circling the D indicate that you "Disagree" somewhat with the statement.
Circling the SD means that you "Strongly Disagree" with the statement.

Thank you for responding honestly to these statements.

(Haury, 1985)

1. Human genetics is too complicated for people like me to understand.

2. In making a personal decision about a medical problem, I would trust my own judgement on the basis of available information more than the advice of knowledgeable friends.

3. For me to solve a physics problem would be more accidental than the result of sound reasoning.

4. Whether or not I could explain an idea in science to a child would depend more on the ability of the child to understand than on my ability to explain.

5. DNA's role in inheritance can be understood to some degree by most people.

6. Any difficulty I may have in understanding a science-related new item will more likely be due to my lack of knowledge than to its theoretical nature.

7. I would consider myself more competent than fortunate if I were able to complete a science experiment successfully.

8. Most scientific concepts are too complex for people like me to comprehend.

9. Making a scientific discovery is more often the result of persistent research than a matter of chance.

10. Most any adult can interpret graphed data after a little practice.

11. Most people need to consult a specialist in order to plan a nutritious diet.

12. More scientific research efforts fail because of incompetent researchers than because of unexpected events.

13. For me, good grades in science courses depend more on instructors having clear and reasonable expectations than on my study habits.

14. For me, using a field guide to correctly identify a tree would be more a matter of good fortune than skill in observation.

15. For me, the probability of purchasing a good personal computer would be greater if I took a dealer's advice than if I made comparisons on my own.

16. For me choosing sides on many environmental issues is like throwing dice, one solution seems as appropriate as another.

17. Science homework which I complete quickly more accurately demonstrates my proficiency than how easy the assignments may be.

18. If I had just completed a major, intensive science project for the year, and a fellow student asked for a good book to read on the topic, I would feel more confident of my teacher's recommendations and suggestions than of my own.

Science Impact Questionnaire

Name

Gender (Check-one): Female _____ Male _____ Age _____

Grade level just completed ____ High School: public ____ private ____

Special Program (IB, magnet school, etc) _____

Part I

This a questionnaire about your interests and experiences in science - related areas. For each of the following statements, circle the statement that is most characteristic of you.

Frequently	Often	Sometimes	Rarely	Never
5	4	3	2	1

1. To what extent have you had the opportunity to work in a University, industrial, or other major science laboratory other than a high school lab?

   5 4 3 2 1

2. To what extend have you had the opportunity to engage in ongoing scientific research?

   5 4 3 2 1

3. To what extend have you had the opportunity to work with a scientist who took time to share his or her scientific interests and skills with you?

   5 4 3 2 1

4. To what extent have you had the opportunity to explore and get to know the different areas of science through attending lectures, seminars and science research sites hosted by scientists?

   5 4 3 2 1

5. To what extent have you been encouraged to pursue a career in science by your parents?

   5 4 3 2 1

6. To what extent have you been encouraged to pursue a career in science by a teacher or counselor?

   5 4 3 2 1

7. To what extent have you felt as if you have friends who share your interest in science?

   5 4 3 2 1

8. Have you had the opportunity to work with a female scientist?

   _____NO _____YES

9. Have you had the opportunity to work with a male scientist?

   _____NO _____YES

10. Are you planning a career in a science-related area?

    _____NO _____YES

11. If YES, in what area? _____

12. If YES, do you have a clear understanding of your career goals and how you will reach them?

    _____NO _____YES

13. If YES, what are your goals, and what steps do you need to take to reach them?

14. Have there been any particular experiences that have influenced your attitude towards a commitment to science as a career path?

    _____NO _____YES

15. If YES, please describe the experiences.

PART 2

Please answer each of the following questions by circling the one that most characterizes you.

SA if you strongly agree with the statement
A if you agree with the statement
N if you are not sure
D if you disagree with the statement
SD if you strongly disagree with the statement

16. Working in a science laboratory expands my awareness and interest in science.

SA A N D SD

17. Engaging in ongoing scientific research increases my motivation and interest in science.

SA A N D SD

18. The experience of working with a scientist encourages me to pursue a career in a science-related field.

SA A N D SD

19. The experience of exploration in science through attending lectures, seminars and research sites has increased my knowledge and interest in science career opportunities.

SA A N D SD

20. Having friends who like science helps maintain my interest in science.

SA A N D SD

21. Do you believe it would be a more positive or negative experience to work with a female scientist instead of a male scientist?

_____NEGATIVE _____POSITIVE _____NO DIFFERENCE

22. Would you prefer to work with a female scientist?

_____NO _____YES

23. Would you prefer to work with a male scientist?

_____NO _____YES

24. I'd select who I work with by the topic and kind of research being conducted, not by gender (sex) of the scientist.

_____NO _____YES

25. For a supervisor/mentor in my research, I'd prefer:

_____a male supervisor_____a female supervisor

_____Don't care about gender

SCIENCE ATTITUDES SCALE

This scale consists of a series of statements. There are no "right" or "wrong" answers to these statements. They have been designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed.

As you read each statement, not your immediate reaction to it. If you strongly agree, circle **SA** on your answer sheet on **page 15.** If you agree, but with reservations, that is, you do not agree completely, circle **A.** If you disagree with the idea, indicate the degree to which you disagree by circling **D** for disagree or **SD** for strongly disagree. But if you are truly ambivalent, that is, neither agree or disagree, circle **N** for not sure.

Do not spend much time with any statement, but be sure to answer every **statement.** Remember, there are no "right" or "wrong" answers. The only correct answers are those that are not true for you.

SA	**A**	**N**	**D**	**SD**
strongly agree	agree	not sure	disagree	strongly disagree

****

1. Figuring out science problems does not appeal to me.
2. For some reason, even though I study, science seems unusually hard for me.
3. My teachers think I'm the kind of person who could do well in science.
4. When a woman has to solve a science problem, is it feminine to ask a man for help.
5. I can get good grades in science.
6. Being regarded as smart in science would be a great thing.
7. My friends of the opposite sex would enjoy discussing science with me.
8. It would be really great to win a prize in science.

9. My friends of the opposite sex don't like it if I get better grades in science than they do.

10. I don't like people to think I'm smart in science.

11. Women's science aptitude is as great as a men's science aptitude.

12. I would expect a successful woman science student to be somewhat unfeminine.

13. My friends have show no interest in whether or not I plan a science career.

14. My father wouldn't encourage me to plan a career which involves science.

15. Science teachers have made me feel I have the ability to go in science.

16. It would make my friends of the opposite sex uncomfortable if I earned higher midterm exam scores in science than they did.

17. My friends feel people should study science because it is important.

18. When a science problem arises that I can't immediately solve, I stick with it until I have the solution.

19. I'm not the type to well in science.

20. Men and women have the potential to be successful science students.

21. My mother thinks I'm the kind of person who could do well in science.

22. I have a lot of self-confidence when it comes to science.

23. I'd be happy to get top grades in science.

24. Most subjects I can handle okay, but I have a knack for messing up in science.

25. As long as I have passed, my mother hasn't cared how I have done in science.

26. Studying science is just as appropriate for women as men.

27. Once I start trying to work on a science puzzle, I find it hard to stop.

28. My friends admire people who are majoring in science.

29. It would make me happy to be recognized as an excellent student in science.

30. My date would think I was strange if I discussed current science topics with him/her.

31. My mother thinks advanced science courses are a waste of time for me.

32. As long as I have passed, my father hasn't cared how I have done in science.

33. My father thinks I'm the kind of person who could do well in science.

34. My science teacher would encourage me to take all the science I can.

35. My father thinks advanced science courses are a waste of time for me.

36. If I get a high score on my science exam, I am hesitant to tell my friends of the opposite sex.

37. I would make my friends of the opposite sex uncomfortable if I earned a higher midterm exam score in science than they did.

38. My father has strongly encouraged me to do well in science.

39. My mother wouldn't encourage me to plan a career which involves science.

40. My teachers have encouraged me to study more science.

41. People who are majoring in science are admired by their peers.

42. Males are not naturally better than females in science.

43. My father has shown no interest in whether or not I take more science courses.

44. My friends think that science is one of the most important subjects to have studied.

(GO ON TO NEXT PAGE FOR THE ANSWER SHEET TO THIS QUESTIONNAIRE)

Thank you for completing these questionnaires honestly.

PRIOR SCIENCE-RELATED EXPERIENCES
QUESTIONNAIRE

1. As a young child in pre-school and elementary school, what were your favorite toys and play activities? (Mark all that apply)

___blocks, legos, or other building sets
___board games
___action games
___dolls
___sports
___crafts
___puzzles
___electronic games/computers
___miniature, moveable figures
___other (please specify) _____

2. Go back to #6 and put an (*) next to the types/games you played with the most.

3. What kinds of science activities did you engage in throughout school?

___working in a science lab
___making plants grow
___making a robot
___doing experiments
___building machines
___dissecting animals
___other (please describe) _____

4. Have you ever built anything that worked?

___NO
___YES If yes, please describe it.

5. Did you participate in science fairs?

___NO
___YES If yes, check the grade levels and describe the projects topics and any awards.

___5th Topic _____ Award _____

___6th Topic _____ Award _____

___7th Topic _____ Award _____

___8th Topic _____ Award _____

___9th Topic _____ Award _____

___10th Topic _____Award _____

___11th Topic _____Award _____

6. Is there someone who encouraged your interest in science?

___NO
___YES If so, describe the person's characteristics and their relationship to you.

APPENDIX C

LETTERS OF PERMISSION

STUDY ONE--PILOT STUDY

Dear Parent,

I am asking you to allow your child to participate in a research study concerning the characteristics of students in AP science classes. Students will complete questionnaires regarding their valuing of science and career interests in science. I am a doctoral student completing my studies in school psychology. I have worked extensively with gifted students and am interested in ways to encourage talented students to pursue science-related careers. This study will take place during one class period and will in no way harm or stress your child. Your child will be asked to complete a packet of questionnaires regarding their feelings toward science and experiences in science.

Participation or non-participation in the study will not affect your child's involvement in school. You are free to withdraw consent and discontinue your child's participation in the study at any time. No discomfort is anticipated in completing the questionnaires. Monetary compensation will not be provided. Although no specific benefits to your child are ;expected by completing the questionnaires, your child's participation will aid in increased understanding of academically talented students' motivation to pursue scientific careers. Please be assured that all information gathered and your child's name will be kept confidential through a coding system. Your child's name will never be published.

If you have any questions, please feel free to call me at (904) 371-1831. If you do not have any questions concerning the study and agree to have your child participate, please sign below and return the form to school with your child tomorrow - to the AP science class teacher. Thank you.

Sincerely,

Deborah M. Harris
Ph.D. Candidate
University of Florida

I have read and understand the description of the research study on students' valuing and career interest in science as described above. I have received a copy of the research study description. I understand that I may withdraw my child at anytime.

_____I agree to allow my child, _____,
to participate in the science career interest study during AP science class.

_____I do no agree to allow my child to participate in the science career interest study.

_____ _____
Parent/Guardian Signature Date

STUDY TWO

Dear Parent,

I am asking you to allow your child, _____, to participate in research study concerning the impact of the Student Summer Training Program on student's valuing of science and career interests in science. I am conducting the study as part of the Student Summer Training Program (SSTP) under supervision of Dr. Betty Abbott, director of the SSTP program. I am a doctoral student completing my studies in school psychology. I have worked extensively with gifted students and am interested in ways to encourage talented science students to pursue science-related careers. This study will take place during the summer science program and will in no way harm or stress your child. Your child will be asked to complete three questionnaires regarding their feelings toward science during a general session the first week of the program. They will again complete the three questionnaires the last week of the program.

Participation or not-participation in the study will not affect your child's involvement in the summer program. You are free to withdraw consent and discontinue your child's participation in the study at any time during the program. No discomfort is anticipated in completing the questionnaires. Monetary compensation will not be provided. Although no specific benefits to your child are expected by completing the questionnaires, your child's participation will aid in increased understanding of academically talented students' motivation to pursue scientific careers. Please be assured that all information gathered and your child's name will be kept confidential through a coding system. Your child's name will never be published.

If you have any further questions, please feel free to call me at (904)371-1831 or reach me through the SSTP office, (904)392-2310. You may also write me in care of the SSTP, Florida Foundation for Future Scientists, University of Florida, Gainesville, FL, 32611. If you have no questions concerning the study and agree to have your child participate, please sign below and return the letter to me in the enclosed envelope.

Sincerely,

Deborah M. Harris
Ph.D. Candidate
University of Florida

I have read and understand the description of the research study on students' valuing and career interest in science as described above. I have received a copy of the research study description. I understand that I may withdraw my child at anytime.

_____I agree to allow my child, _____, to participate in the science career interest study during SSTP.

_____I do not agree to allow my child to participate in the science career interest study.

_____ _____
Parent/Guardian Signature Date

_____ _____
Parent/Witness Signature Date

APPENDIX D

TABLES

Table D-1
Correlation Coefficients for TOSRA Subscales

Males

TOSRA Subscales	S	N	I	A	E	L	C
Social Implication of Science							
r	1	.434	.301	.436	.630	.625	.680
p	0	.001	.033	.001	.0001*	.0001*	.0001*
Normality of Scientists							
r	.434	1	.125	.432	.530	.585	.432
p	.002*	0	.390	.001*	.0001*	.0001*	.001*
Attitude to Scientific Inquiry							
r	.302	.125	1	.406	.580	.456	.576
p	.033*	.390	0	.003*	.0001*	.0009*	.0001*
Adoption of Science Attitudes							
r	.436	.432	.406	1	.614	.576	.519
p	.001	.002*	.003*	0	.0001*	.0001*	.0001*
Enjoyment of Science Lessons							
r	.630	.530	.580	.614	1	.814	.746
p	.0001*	.0001*	.0001*	.0001*	0	.0001*	.0001*
Leisure Interest in Science							
r	.625	.585	.455	.576	.814	1	.765
p	.0001*	.0001*	.0009*	.0001*	.0001*	0	.0001*
Career Interest in Science							
r	.680	.431	.576	.518	.746	.765	1
p	.0001*	.0017*	.0001*	.0001*	.0001*	.0001*	0

Table D-1 (continued)

Females							
TOSRA Subscales	S	N	I	A	E	L	C
Social Implication of Science							
r	1	.076	.355	.440	.523	.456	.529
p	0	.611	.0143*	.001	.0002*	.001*	.0001*
Normality of Scientists							
r	.076	1	.250	.004	-.037	.007	-.124
p	.611	0	.088	.978	.800	.959	.403
Attitude to Scientific Inquiry							
r	.355	.250	1	.446	.457	.326	.341
p	.014*	.088	0	.001*	.001*	.025*	.019*
Adoption of Scientific Attitudes							
r	.440	.004	.446	1	.390	.436	.611
p	.002*	.978*	.007*	0	.007*	.002*	.0001*
Enjoyment of Science Lessons							
r	.523	-.038	.457	.389	1	.817	.606
p	.0002*	.800	.001*	.007*	0	.0001*	.0001*
Leisure Interest in Science							
r	.456	.007	.326	.436	.817	1	.613
p	.001*	.959	.025*	.002*	.0001*	0	.0001*
Career Interest in Science							
r	.529	-.125	.341	.611	.606	.613	1
p	.0001*	.403*	.019*	.0001*	.0001*	.0001*	0

Table D-2
Science Impact Questionnaire Items-Pretest

Items of Interest	Males (n=49)		Females (n=47)	
Characteristic Experiences	Most Frequent Response	Percent	Most Frequent Response	Percent
1. Experience working in a lab beyond school	never	33	rarely	38
2. Engaging in ongoing research	never/rarely	29	rarely	40
3. Working with a scientist	rarely	31	never	36
4. Exploring science areas	rarely	33	rarely	28
5. Encouraged by parents	frequently	43	frequently	43
6. Encouraged by counselor/teacher	often	37	frequently	34
7. Friends who share interest	sometimes	37	sometimes	32
8. Planning science career	yes	84	yes	73
9. Most frequent area of science	1st-Engineering	33	1st-MD/Health	45
	2nd- MD/Health	27	2nd-Engineering	19
10. Clear career goals in science	No	51	No	57
11. Clarity of goals and way to achieve	No	51	No	55
	Vague	25	Vague	9
	Somewhat Clear	16	Somewhat clear	19
	Clear	8	Clear	17

Table D-2 (continued)

Activities/Experiences of Students				
	Males		Females	
Characteristic Experiences	Most Frequent Response	Percent	Most Frequent Response	Percent
1. Working in lab expands awareness & interest in science	SA/A	49	SA	60
2. Doing scientific research increases motivation & interest	A	45	SA	55
3. Working with scientist encourages career interest	SA	41	SA	38
4. Exploring science topics increases career interest	A	59	A	53
5. Having friends in science helps keep an interest in science	A	43	A	40
Experiences That Influenced Science Interest				
1. Student who had experiences	Yes	69	Yes	75
2. Father	Yes	18	Yes	13
3. Mother	Yes	10	Yes	9
4. Other family member	Yes	10	Yes	4
5. Teacher	Yes	6	Yes	11
6. Adult mentor/scientist	Yes	8	Yes	15
7. Personalized experience	Yes	2	Yes	19
8. School classes/courses	Yes	2	Yes	15

Table D-2 (continued)

Characteristic Experiences	Males		Females	
	Most Frequent Response	Percent	Most Frequent Response	Percent
Experiences That Influenced Science Interest (continued)				
9. Work in lab/field	Yes	8	Yes	9
10. Special Programs	Yes	12	Yes	13
11. Good grades	Yes	2	Yes	2
12. Science Fairs	Yes	6	Yes	4
13. Awards	Yes	2	Yes	4
14. Way of thinking	Yes	6	Yes	6
15. Talent/ability	Yes	6	Yes	4
16. Love of it	Yes	14	Yes	19
17. Reading/T.V.	Yes	6	Yes	6
18. SSTP	Yes	2	Yes	9

Table D-3
Gender Differences in Prior Hands-On Science-Related Experiences

Hands-On Experiences	Males		Females	
Favorite Toys When Young	N	Percent	N	Percent
Blocks	45	90	40	85
Board Games	32	64	29	68
Action Games	24	48	17	36
*Dolls	1	2	25	53
Sports	29	58	17	36
Crafts	7	14	25	53
Puzzles	27	54	33	70
Electronic Games/Computers	32	64	17	36
Miniature Figures	30	60	21	45
Toys Played With the Most	Frequency	%	Frequency	%
Blocks	28	56	13	28
Board Games	12	24	15	32
Action Games	10	20	4	9
*Dolls	0	0	16	34
Sports	10	20	12	26
Crafts	1	2	9	19
Puzzles	6	12	18	38
Electronic Games/Computers	17	34	4	9
Miniature Figures	15	30	7	15

*Dolls were not part of the "hands-on" total score.

Table D-3 (continued)

Hands-On Experiences	Males		Females	
Science Activities In School	Frequency	%	Frequency	%
Working in Science Lab	27	54	26	55
Making Plants Grow	11	22	14	30
Making a Robot	3	6	1	2
Doing Experiments	36	72	36	77
Building Machines	7	14	3	6
Dissecting Animals	25	50	27	57
Built Something That Worked	31	62	19	40
Science Fair Participation	Frequency	%	Frequency	%
Yes	45	90	39	83
5th Grade	9	18	14	30
6th Grade	17	34	14	30
7th Grade	22	44	11	23
8th Grade	30	60	17	36
9th Grade	25	50	17	36
10th Grade	20	40	19	40
11th Grade	17	34	16	34

Table D-4
Science Impact Questionnaire Items-Post Test

Items of Interest	Males (n=47)		Females (n=47)	
Characteristic Experiences	Most Frequent Response	Percent	Most Frequent Response	Percent
1. Experience working in lab beyond school	sometimes	30	rarely &	40.4
			sometimes/often	21.3
2. Engaging in ongoing research	sometimes	28	rarely	40
3. Working with scientist	sometimes	38	rarely	38
4. Exploring science areas	rarely/sometimes/often	2	rarely	32
5. Encouraged by parents	often/frequently	30	frequently	30
6. Encouraged by counselor/teacher	often	38	often	32
7. Friends who share interest	sometimes	40	sometimes	38
8. Planning science career	yes	75	yes	57
9. Most frequent area of science	1st-Engineering	34	1st-MD/Health	45
	2nd- MD/Health	23	2nd-Engineering	13
10. Clear career goals in science	no	49	no	57
	yes	51	yes	43
11. Clarity of goals and way to achieve	no	51	no	53
	vague	36	vague	19
	somewhat clear	4	somewhat clear	17
	clear	9	clear	11

Table D-4 (continued)

Items of Interest	Males (n=47)		Females (n=47)	
Characteristic Experiences	Most Frequent Response	Percent	Most Frequent Response	Percent
Activities/Experiences Reported After the Intensive Science Experience				
1. Working in lab expands awareness & interest in science	SA/A	45	SA	62
2. Doing scientific research increases motivation & interest	A	53	SA	60
3. Working with scientist encourages career interest	A	43	A	60
4. Exploring science topics increases career interest	A	40	A	64
5. Having friends in science	A	43	A	53
Experiences Influencing Science Interests Reported After Intensive Science Experience				
1. Student who had experiences	Yes	47	Yes	60
2. Father	Yes	6	Yes	2
3. Mother	Yes	4	Yes	4
4. Other family member	Yes	4	Yes	4
5. Teacher	Yes	0	Yes	9
6. Adult mentor/scientist	Yes	6	Yes	4
7. Personalized experience	Yes	0	Yes	11
8. School classes/courses	Yes	2	Yes	2
9. Work in lab/field	Yes	6	Yes	9

Table D-4 (continued)

Items of Interest	Males (n=47)		Females (n=47)	
Characteristic Experiences	Most Frequent Response	Percent	Most Frequent Response	Percent
10. Special Programs	Yes	2	Yes	2
11. Good grades	Yes	0	Yes	0
12. Science Fairs	Yes	6	Yes	6
13. Awards	Yes	0	Yes	0
14. Way of thinking	Yes	0	Yes	2
15. Talent/ability	Yes	2	Yes	2
16. Love of it	Yes	2	Yes	4
17. Reading/T.V.	Yes	4	Yes	2
18. SSTP	Yes	15	Yes	30

Table D-5
Correlation of of the Science Attitude Survey Subscales

Males

Subscales	PANT	ABIL	PEERS	CMFA	PEOP	SUCC	TCHR
Parental Encouragement							
r	1	.753	.182	.458	.429	.535	.307
p	0	.0001*	.200	.0007*	.0016*	.0001*	.028*
Confidence in Science							
r	.753	1	.162	.384	.452	.742	.509
p	.0001*	0	.255	.0053*	.0008*	.0001*	.0001*
Peer's Feelings About Science							
r	.182	.162	1	.185	.102	.183	.240
p	.200	.255	0	.191	.475	.196	.088
Attitude Toward Women in Science							
r	.458	.384	.185	1	.426	.177	.019
p	.0007*	.0053*	.191	0	.0018*	.213	.893
Competition With Peers of Opposite Sex							
r	.429	.452	.101	.426	1	.308	.143
p	.0016*	.0008*	.475	.0018*	0	.0275*	.316
Feelings About Success							
r	.535	.742	.183	.177	.308	1	.617
p	.0001*	.0001*	.196	.213	.0275*	0	.0001*
Teachers' Confidence							
r	.307	.509	.240	.019	.143	.617	1
p	.028*	.0001*	.088	.893	.316	.0001*	0

Table D-5 (continued)

Females

Subscales	PANT	ABIL	PEERS	CMFA	PEOP	SUCC	TCHR
Parental Encouragement							
r	1	.400	.266	.386	.087	.506	.296
p	0	.0052*	.0699	.0073*	.557	.0003*	.043*
Confidence in Science							
r	.400	1	.262	.232	-.087	.493	.366
p	.0052*	0	.074	.116	.557	.0004*	.011*
Peer's Feelings About Science							
r	.266	.262	1	.401	.060	269	.466
p	.069	.074	0	.005*	.684	.067	.0009*
Attitude Toward Women in Science							
r	.386	.232	.401	1	.363	.498	.447
p	.0073*	.116	.0051*	0	.012*	.0004	.0016*
Competition With Peers of Opposite Sex							
r	.087	-.087	.0608	.363	1	.133	-.008
p	.557	.557	.684	.012*	0	.372	.955
Feelings About Success							
r	.506	.493	.269	.498	.133	1	.374
p	.0003*	.0004*	.067	.0004*	.372	0	.0095*
Teachers' Confidence							
r	.296	.366	.466	.447	-.008	.374	1
p	.043*	.011*	.0009*	.0016*	.955	.0095*	0

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BIOGRAPHICAL SKETCH

Deborah McGavin Harris was born in Chicago, Illinois, on October 11, 1953. Soon after, she moved to Palm Beach, Florida. There she grew up and attended Palm Beach Public Elementary and Junior High School and Twin Lakes High School. She attended the University of Florida as an undergraduate and received a Bachelor of Arts Degree in elementary education.

After teaching school for two years in Palm Beach and three years in Germany and Scotland, she returned to graduate school at the University of Florida to pursue a graduate degree in school psychology. She received her Ed.S. degree in 1983, and continued graduate work toward a Ph.D. also in school psychology.

Ms. Harris worked at P. K. Yonge Laboratory School while pursuing her graduate degree. She began as an art teacher and, while in this position, coauthored a grant to begin a program for gifted and talented students. She coordinated the program as it grew considerably over the years. Ms. Harris became very involved in gifted education at the local, state, and national level through her work in an institute for gifted education, presentation of papers at national conferences,

involvement on the state gifted organization's executive board, and the creation of a local advocacy organization for gifted education.

She presently is the director of the P. K. Yonge Gifted and Talented Program and also works part-time as a private school psychologist specializing in the psycho-educational needs of gifted and talented youngsters.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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